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THE
PRINCIPLES AND PRACTICE
OF
DENTISTRY

INCLUDING

ANATOMY, PHYSIOLOGY, PATHOLOGY, THERA-
PEUTICS, DENTAL SURGERY
AND MECHANISM.

BY

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OF MEDICAL TERMINOLOGY AND DENTAL SURGERY."

Thirteenth Edition.

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PART THIRD.

DENTAL SURGERY.

Besides the operations of General Surgery which are performed upon the mouth, in common with other parts of the body, Dental Science gives specific directions for those operations of Special Surgery demanded in the—

1. Correction of Irregularities in the Arrangement of the Teeth.
2. Treatment of Dental Caries.
3. Extraction of Teeth.
4. The Use of Anesthetic Agents.
5. Dislocation and Fracture of the Jaw.
6. Diseases of the Maxillary Sinus or Antrum.
7. Caries of the Maxillary Bones.

CHAPTER I.

IRREGULARITY OF THE TEETH—ORTHODONTIA.

Method of Directing Second Dentition.—To properly direct second dentition a knowledge of the relative position of the permanent and temporary teeth at a period soon after the appearance of the first teeth of the permanent set is necessary. Fig. 159 represents the jaws of a child between six and seven years of age, all of the temporary teeth being in position and the six-year molars erupting.

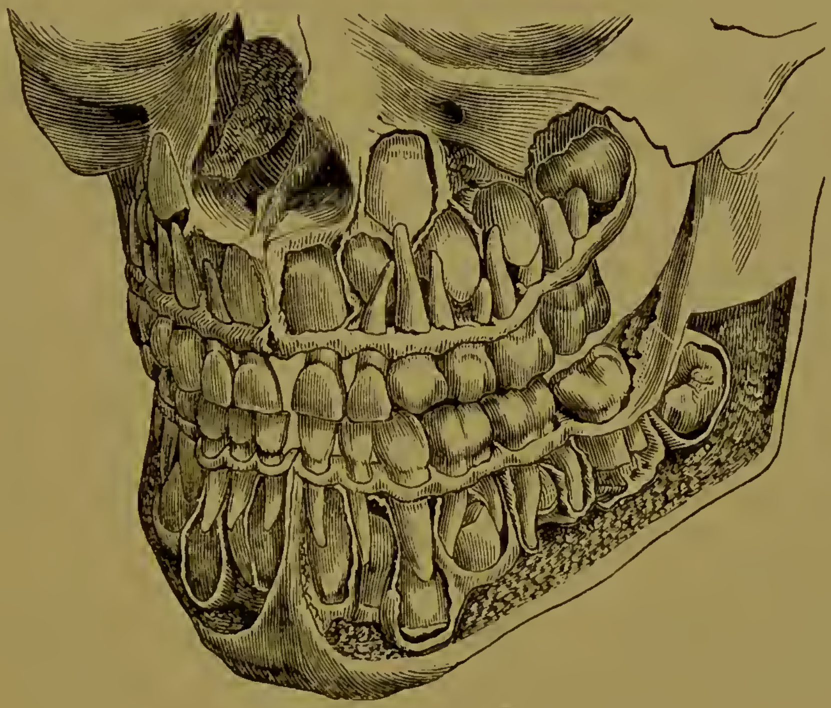


FIG. 159.

The developing crowns of the permanent teeth occupy a higher place than the temporary teeth, and the superior central incisors have a more outward inclination, on account of their size and the increased width of the arch they are to occupy when erupted. The crowns and a small portion only of the roots of these teeth are completed, and they are placed directly under and in contact with the floor of the nares. The superior lateral incisors are not so far advanced in their development as the central incisors, and their crowns are situated beneath the angle of the nares and back of the roots of the temporary laterals and canines.

The canines are situated on a higher plane than either the central or lateral incisors, not more than one-fourth of an inch below the infra-orbital canals and along the sides of the outer walls of the nares, with their crowns about completed. The crowns of the first and second superior bicuspids are situated on the same plane as the lateral incisors, being embraced by the roots of the first and second temporary molars, and are but partly developed. The crowns of the first permanent molars of both jaws have erupted and are about antagonizing with each other, but their roots are only one-half formed. The crowns of the permanent second molars are but partly developed, and are situated above and posterior to the roots of the first permanent molars, their grinding surfaces having a direction downward and slightly backward toward the lower portion of the external pterygoid processes. The dentes sapientiæ of the upper jaw are represented by small crypts only, in a higher plane in the maxillary tuberosities.

The inferior permanent central incisors are situated directly behind the roots of the temporary incisors, and have their crowns completed with about one-fourth of their roots. The roots of the permanent lateral incisors are not so far developed and are situated somewhat back of the crowns of the permanent central incisors and canines. The permanent central and lateral incisors, as do all of the inferior teeth, occupy a vertical position in the jaws, on account of the inferior dental arch being smaller than the superior. The inferior permanent canines occupy a lower plane than the incisors, and the partly developed roots extend very near to the under surface of the bone of the jaw. The position and stage of development of the inferior permanent bicuspids and first molars are about the same as those of the corresponding teeth of the upper jaw.

The developing crowns of the permanent second molars occupy a higher plane than that of the bicuspids, and their grinding surfaces have a direction upward and forward. The inferior dentes sapientiæ are represented by small crypts only, in the coronoid processes.

There is nothing more destructive to the beauty, health, and durability of the teeth, and no disturbance more easily prevented, than irregularity of their arrangement. Also, in proportion to the deviation of these organs from their proper position in the alveolar arch are the features of the face and the expression of the countenance injured. It also increases the susceptibility of the gums and peridental membrane to morbid impressions.

It is important, therefore, that the mouth, during second dentition, should be properly cared for; and so thoroughly convinced is the author of this, that he does not hesitate to say that if timely precautions were used there would not be one decayed tooth where there are now a dozen.

Much harm, it is true, may be done by improper meddling with the teeth during this period, but this, so far from inducing a total neglect, should only make those having the care of children more solicitous in securing the services of scientific, accomplished practitioners.

For the judicious management of second dentition, much judgment and a correct knowledge of the normal periods of the eruption of the several classes of teeth are required. All unnecessary interference with these organs at this early period of life should certainly be avoided, as it will only tend to mar the perfection at which nature ever aims. The legitimate duty of the physician being, as Mr. Bell correctly observes, "the regulation of the natural functions when deranged," he should never anticipate the removal by nature of the temporary teeth unless their extraction is called for by some pressing emergency, such as a deviation of the permanent ones from their proper place, alveolar abscess, or exfoliation of the alveolar processes.

The mouth should be frequently examined from the time the shedding of the deciduous teeth commences until the completion of second dentition; and when the growth of the permanent teeth so far outstrips the destruction of the roots of the temporary that the former are caused to take an improper direction, such of the latter as have occasioned the obstruction should be immediately removed. In the dentition of the upper front teeth this should never be neglected; for when they come out behind the temporaries, as they most frequently do, and are permitted to advance so far as to fall on the inside of the lower incisors, a permanent obstacle is offered to their subsequent proper adjustment.

When a wrong direction has been given to the growth of the lower front teeth, they are rarely prevented from acquiring their proper arrangement by an obstruction of this sort. They should not, however, on this account be permitted to occupy an erroneous position too long; for the evil will be found easier of correction while recent than after it has continued for a considerable length of time. The irregularity should be immediately removed.

The permanent central incisors of the upper jaw being larger than the temporaries of the same class, it might, therefore, be supposed that the aperture formed by the removal of the one would not be sufficient for the admission of the other without an increase in the size of this part of the maxillary arch. It should be recollected, however, that by the time these teeth usually emerge from the gums, the crowns of the temporary lateral incisors are so much loosened by the partial destruction of their roots as to yield sufficiently to the pressure of the former to permit them to take their proper position within the dental circle. When this does not happen, the temporary laterals should be extracted.

Under similar circumstances the same course should be pursued with the permanent lateral incisors and the temporary cuspids, and also with the permanent cuspids and the first bicuspids.

But from the fact that the bicuspids are erupted before the permanent cuspids, the premature extraction of the temporary cuspids is often the cause of the projection of one or more of the front teeth; sometimes to such a degree as to produce considerable deformity.

The removal of the temporary cuspids should therefore be avoided when there is reason to believe that the growth of the jaw will provide sufficient space for a deviating permanent lateral incisor to take a proper position within the dental arch.

The bicuspids being situated between the roots of the temporary molars are seldom caused to take an improper direction in their growth. Nor are they often prevented from coming out in their proper place for want of room.

In the management of second dentition much will depend on the experience and judgment of the practitioner. If he be properly informed upon the subject, and gives to it the necessary care and attention, the mouth will in most instances be furnished with a healthful, well arranged, and beautiful set of teeth. At this time "an opportunity," says Mr. Fox, "presents itself for effecting this desirable object" (the prevention of irregularity), "but everything depends upon a correct knowledge of the time when a tooth requires to be extracted, and also of the particular tooth, for often more injury is occasioned by the removal of a tooth too early than if it be left a little too long; because a new tooth which has too much room long before it is required will sometimes take a direction more difficult to alter than a slight irregularity occasioned by an obstruction of short duration."

The temporary teeth by remaining too long are likely to affect the arrangement, and consequently the health, of the permanent teeth, and they should be extracted, because, in that case, their presence is a greater evil than any that would be occasioned by their removal. As a general rule, they should be suffered to remain until their presence is likely to injure the permanent teeth and their contiguous parts.

When the permanent teeth are crowded, the lateral pressure is frequently so great as to fracture the enamel. If this cannot be prevented in any other way, one on each side should be extracted. It is better to sacrifice two than permanently to endanger the health of the whole.

The file or revolving discs and points upon the dental engine should never be used with a view to remedy irregularity; the extraction of two teeth, one on each side of the jaw, however small the space required to be gained may be, is far preferable. The second bicuspids, *cæteris paribus*, should always be removed rather than the first, but sometimes the extraction of the first becomes necessary.

By the removal of the teeth ample room will be gained for the arrangement of all the remaining ones, and the injury resulting from a crowded condition of the organs prevented.

The author does not, however, wish to be understood as conveying the idea that cutting away a portion of the teeth necessarily causes them to decay, for, when the file or disc is used for any other purpose than to gain room, the apertures may be made large enough to prevent the approximation of the organs, and thus the bad effects resulting from the operation will be prevented.

The extraction of the root of a superior front tooth, a central incisor, for example, when the crown has been greatly disfigured or wholly destroyed by mechanical violence, may cause the superior front teeth to fall behind the inferior teeth. Should such a deformity not occur, it frequently happens that an unsightly space is left, too small for the insertion of an artificial tooth to correspond in size with the adjoining natural ones.

To avoid such results the root should be allowed to remain and the proper treatment instituted to subdue the inflammation, the pulp removed when exposed, and the root filled to the apex with gold or other suitable material. By pursuing such a course the root is retained until such a time as its removal will not affect the adjoining teeth. In some cases the portion of the crown destroyed may be restored with gold, or an artificial crown inserted on a pivot.

When the deciduous canines are extracted on the approach of the permanent lateral incisors, the first bicuspids will move forward and occupy the space necessary for the reception of the permanent canines, which may erupt over the laterals, and by their pressure cause these latter teeth to shut within the lower teeth.

Fig. 160 illustrates the mischief attending the premature extraction of the deciduous canines.

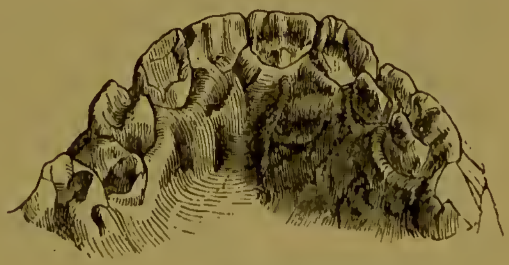


FIG. 160.

Nature, when permitted to proceed with her work without interruption, is able to perform her operations in a perfect and harmonious manner. But the functional operations of all the parts of the body are liable to be disturbed, from an almost innumerable number and variety of causes, and impairment of one organ often gives rise to derangement of the whole organism, for the relief of which the interposition of art not unfrequently becomes necessary, and it is fortunate for the well-being of man that it can in so many instances be applied with success.

In sound and healthy constitutions the services of the dentist are seldom required to assist or direct second dentition. In remarking upon this subject, Dr. Koecker observes, that "the children for whom the assistance of a dentist is most frequently sought are those who are in delicate, or at least imperfect, constitutional health; in whom the state not only of the temporary teeth, but of the permanent also, is to be considered, and where both are found to be diseased the future health and regularity of the latter require the greatest consideration of the surgeon.

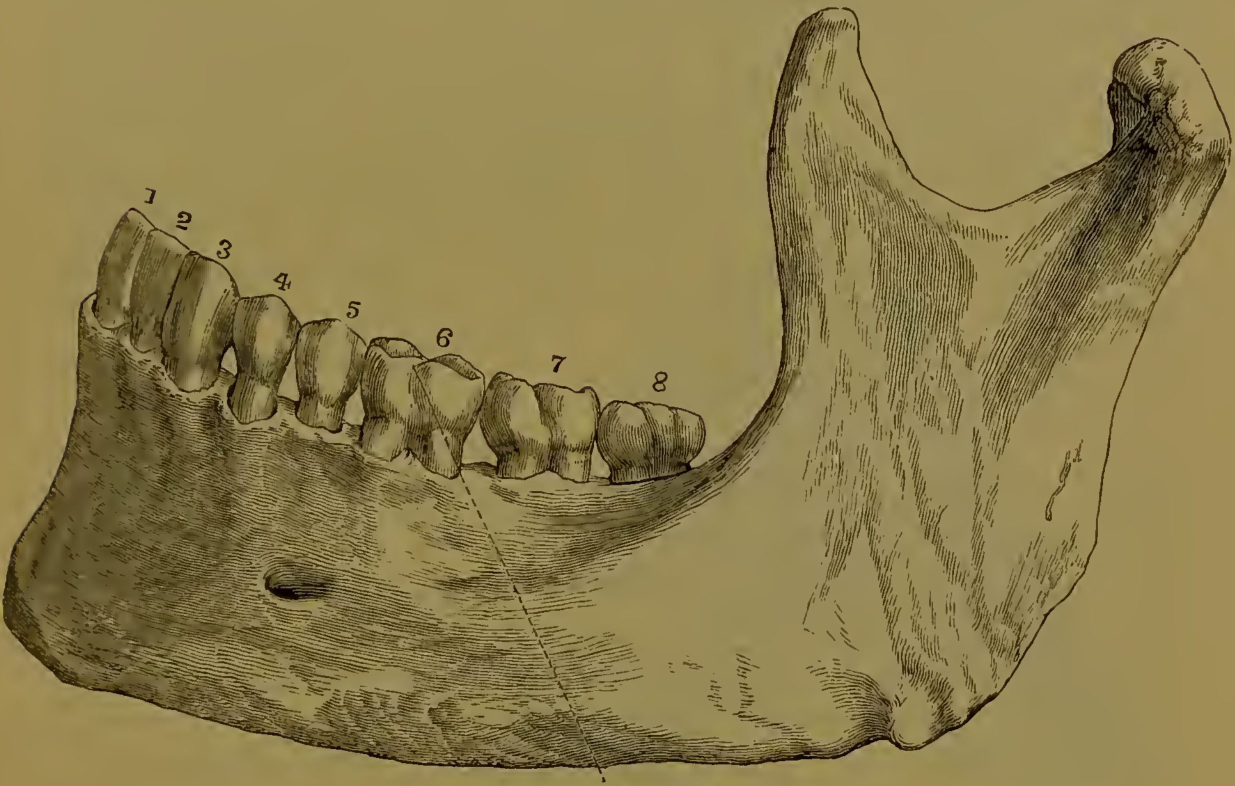
"Irregularity of the teeth is one of their chief predisposing causes of disease, and never fails, even in the most healthy constitutions, to destroy, sooner or later, the strongest and best set of teeth unless properly attended to. It is thus not only a most powerful cause of destruction to the health and beauty of the teeth, but also to the regularity and pleasing symmetry of the features of the face, always producing, though slowly and gradually, some irregularity, and not unfrequently the most surprising and disgusting appearance."

Though nature is generally able to accomplish the task assigned her, yet there are times when she requires aid, and it is then, and then only, that the services of the dentist are needed. Therefore, whilst on the one hand we should guard against any uncalled-for interference, we should on the other always be ready to give such assistance as the nature of the disturbance presented to our notice may require.

The progress of caries in the temporary teeth is very rapid, as a general rule, owing to the large proportion of organic matter compared with the inorganic. Alveolar abscess is, therefore, a common result of the loss of vitality, and the absorption of the alveolar processes from such a cause may expose the apex of the root of one or more temporary teeth.

In the case of the necrosed roots of the superior incisors presenting such a condition, and it is necessary that such teeth should be preserved in order to prevent an irregular arrangement of the succeeding permanent ones, which is very prone to occur from the premature loss of the temporary teeth, the exposed ends of the roots of the necrosed temporary teeth may be excised and carefully rounded off with the file or corundum point. By such a method the necrosed teeth may be retained in the mouth until the period of shedding has arrived, and the space necessary for the reception of the corresponding permanent teeth be preserved.

The eruption of the permanent teeth begins before any of the temporary teeth are shed, the first of the permanent teeth to appear being the sixth-year molars, between five and a half and six and a half years. These teeth are often mistaken for temporary teeth, and being prone to decay, on account of defective structure and the early period of their eruption, they are frequently lost early in life. But as the sixth-year molars perform an important part in the preservation of the integrity of the arch, their retention is desirable if possible. Cases, however, occur where they cannot be permanently preserved, when every effort should be made to preserve them up to a certain period, namely, until the twelfth-year molars are about to erupt, or until a period between the tenth and twelfth years. If the sixth-year molars



Sixth-Year Molar.
Fig. 161.

are lost earlier than the period named, the adjoining teeth will close up and cause irregularity when the other teeth appear. On the other hand, if the sixth-year molars are lost later than the time named, the space they occupied is never compactly closed, and the adjacent teeth will incline toward the vacant space, and the continued occlusion in mastication will cause them to tip over to such a degree as to result in a decided impairment of the occlusion. Such irregular teeth may also become painful and loose, on account of the recession of the gums and the absorption of the alveolar processes, and even the adjoining teeth may suffer in a similar manner.

Fig. 161 represents an adult lower jaw, side view.

Irregularity of Arrangement of the Teeth.—The causes of the various forms of irregularity of the teeth are divided into *accidental*—those occurring after the eruption of the teeth, and *congenital*—those occurring prior to their eruption.

The accidental forms of irregularity are most commonly caused by the presence of temporary teeth beyond the proper time of shedding, owing to the process of absorption of their roots not being commensurate with the development of the permanent teeth, or to the presence of necrosed roots of temporary teeth which are not absorbed. The congenital forms of irregularity are generally caused by a want of development of the jaws commensurate with the size of the teeth. In some rare cases the excessive development of the maxillæ may result in abnormal spaces between the teeth.

The temporary teeth seldom deviate from their proper place in the alveolar arch; but irregularity of arrangement is of frequent occurrence in the permanent teeth, especially the cuspids and incisors. The first and second molars are seldom irregular, for, like the teeth of first dentition, they rarely encounter obstruction in their growth and eruption. The sixth-year molars being the first of the permanent set to appear, the ten anterior teeth are limited to that part of the arch occupied by the ten temporary teeth; if this space is too small, irregularity must of necessity ensue.

The dentes sapientiæ are sometimes irregularly erupted, in consequence of a want of correspondence between the development of the tooth and the growth of the maxilla. The tooth in such cases takes usually the direction of least resistance, the crown presenting more or less obliquely forward, backward, outward, or inward. Of these four positions the first and fourth are found usually in the lower jaw; the second and third are most common in the upper jaw.

When a bicuspid is forced from its proper place it turns inward toward the tongue or outward toward the cheek, accordingly as it is in the upper or lower jaw; or it may be so turned in its cavity by the occlusion of the teeth in the opposite jaw, the loss of an adjoining tooth giving the necessary space, as to present one of its proximate surfaces toward the cheek. The cuspids, when prevented from coming out in their proper place, make their appearance either before or behind the other teeth. When they come out anteriorly, which they do more frequently than posteriorly, they often become a source of annoyance to the upper lip, excoriating and sometimes ulcerating the mucous membrane.

The incisors of the upper jaw present a greater variety of abnormal arrangement than any of the other teeth. The centrals come out sometimes before and sometimes behind the arch; at other times their median sides are turned either directly or obliquely forward toward the lip. The laterals sometimes appear half an inch behind the arch, looking toward the roof of the mouth; at other times they come out in front of the arch, and at other times, again, they are turned obliquely or transversely across it.

When any of the upper incisors are transversely inclined toward the interior of the mouth, the lower teeth at each occlusion of the jaws shut before them and become an obstacle to their adjustment. This form of irregularity often interferes with the lateral motion of the jaw.

The lower incisors sometimes shut in this manner even when there is no inward deviation of the upper teeth. In this case the irregularity is owing to preternatural elongation of the lower jaw, which arises more frequently from some fault of dentition than from any congenital defect in the jaw itself.

Sometimes the superior maxillary arch is so much contracted, and the front teeth in consequence so prominent, that the upper lip is prevented from covering them. Cases of this kind, however, are rarely met with, but when they do occur it occasions much deformity of the face and forms a species of irregularity very difficult to correct. From the same cause the lateral incisors are sometimes forced from the arch and appear behind the centrals and cuspids, the dental circle being filled with the other teeth.

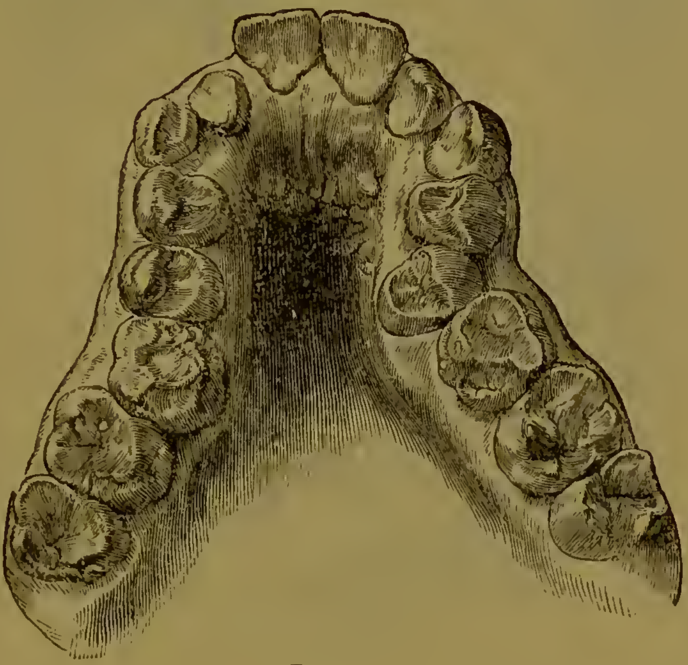


FIG. 162.

An abnormal prominence of the superior incisors may be either congenital or accidental, and when of the former origin it is almost invariably accompanied with a contracted arch, especially between the bicuspids of the right and left sides of the mouth, the incisors occupying a V-shaped position (Fig. 162).

When this form of irregularity has an accidental origin, it is generally caused by a pernicious habit of thumb, tongue, or artificial nipple-sucking.*

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* Such a habit as thumb-sucking may be prevented by the application of some bitter substance, such as aloes, to the thumb, tying the arms close to the body at night, or the wearing of coarse, heavy gloves.

V shaped arch

Figs. 163 and 164 represent the form of irregularity caused by thumb-sucking.

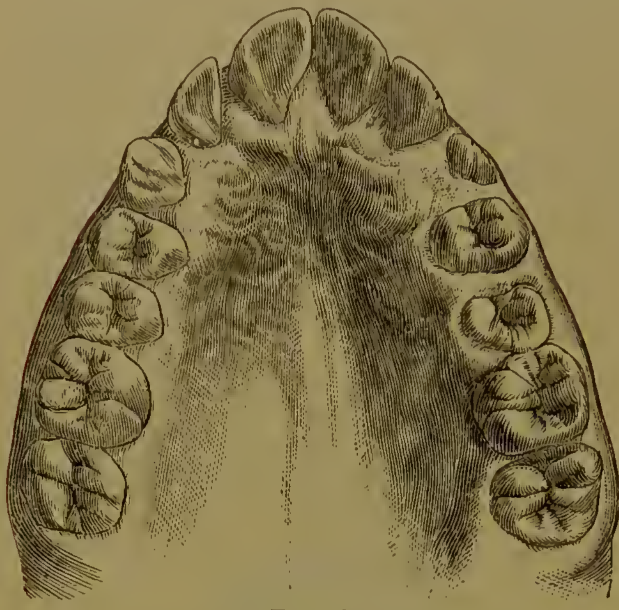

Fig. 163.

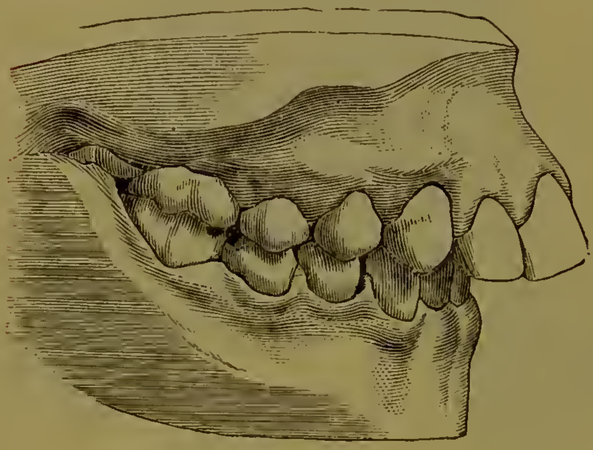

Fig. 164.

An unusual prominence of the superior incisors, attended with a diminution of space between the bicuspids and an abnormally high vaulting of the palate, has been thought by some to be very common to congenital idiots. But Drs. N. W. Kingsley and J. W. White, who examined the inmates of some large institutions for the care of the feeble-minded, found that such a defect is not an invariable rule, as only a small percentage of pronounced irregularity in form of the jaws or arrangement of the teeth, and that generally associated with the lowest type of idiocy, was common to such a class of persons.

Tonsillitis has also been named by Mr. Tomes as a cause for a contracted arch between the opposite bicuspids, the labored breathing from the filling up of the fauces by the enlarged tonsils, with the mouth open, causing increased compression of the cheeks over the lateral parts of the mouth, while the median portion escapes the controlling pressure which would be exercised when the mouth is closed.

Dr. Kingsley is of the opinion that the V-shaped arch is nearly always of congenital origin—that is, an inherited tendency, while the broad or rounded form of arch is often due to mechanical causes.

Inflammation of the throat early in life in children of a strumous diathesis will not only produce deformity of these parts, but irregularity of arrangement of the teeth, by causing tension of the muscles, which has the effect of contracting the oro-naso-pharyngeal space by pressing the lateral portions of the walls inward.

The retention in the jaw of permanent teeth is also a cause of irregularity, as in some cases bicuspids and molars may not erupt sufficiently to meet the opposing teeth.

There are many other deviations in the arrangement of the incisors. Mr. Fox mentions one that was caused by the presence of two supernumerary teeth of a conical form, situated partly behind and partly between the central incisors, which in consequence were thrown forward, while the laterals were placed in a line with the supernumeraries. The central incisors, though half an inch apart, formed one row, and the laterals and supernumeraries another. Mr. Fox says he has seen three cases of this kind. This description of irregularity is rarely met with.

M. Delabarre says that cases of transposition of the germs of the teeth occasionally occur, so that a lateral incisor takes the place of a central, and a central the place of a lateral. A similar transposition of a cuspid and lateral incisor is, also, sometimes seen. Two cases of this sort have fallen under the observation of the author.

The incisors of the lower jaw, being smaller than those of the upper and in other respects less conspicuous, do not so plainly show an irregularity in their arrangement, nor is the appearance of an individual so much affected by it. Still it should be guarded against; for such deviation, whether in the upper or lower jaw, may prove injurious to the health of the teeth and the beauty of the mouth. The growth of the inferior permanent incisors is sometimes more rapid than the destruction of the roots of the corresponding temporaries. In this case the former emerge from the gum behind the latter, and sometimes so far back as greatly to annoy the tongue and interfere with enunciation. At other times the permanent centrals are prevented from assuming their proper place, because the space left for them by the temporaries is not sufficient. The irregularity in the former of these two cases is greater than in the latter. The same causes in like manner affect the laterals.

M. Delabarre mentions a defect in the natural conformation of the jaws, by which the upper temporary incisors on one side of the median line are thrown on the outside of the lower teeth, while the corresponding teeth on the other side of the same line fall within. The same arrangement, he says, may be expected, unless previously remedied, in the permanent teeth. The author has met with but two cases of this sort, and the subjects of these he did not see until after they had reached maturity.

Referring to an ingrafted tendency in all living matter to reproduce itself, Dr. Kingsley remarks: "I am of the opinion that such deformities, even when transmitted for generations, may have the tendency stamped out by being corrected immediately on their development; that is, before the deformity has made its fixed impression upon the individual."

Mr. Mummery is of the opinion that a large amount of dental disease is originated by overtaxing the brain action of children, and Dr. Kingsley remarks that "the next generation will see more abnormality in dental development and an increase of nervous and cerebral diseases, and that the two are correlated and spring from the same cause.

Treatment of Irregularity.—Orthodontia, or the treatment of irregularity, should accord with the indications of nature. When the irregularity is neither great nor complicated, and its causes are removed before the nineteenth or twentieth year, the teeth, without the aid of art, will in many cases assume the proper position. When, however, the efforts of the economy are unavailing, recourse should be had to the dentist, who can, in most instances, bring the deviating organs to their proper position in the arch. The general rule is, that as soon after the eruption of a tooth as it becomes certain that it will assume an irregular position, interference is justifiable, as every year not only increases the difficulties, but impairs the stability of the dental organs. Teeth incline to return to their places on the removal of the cause of irregularity. They may be also made to change position under the influence of pressure. The pressure must be constant; it must be sufficient to cause motion, yet not so great as to set up destructive inflammation; lastly, it must be continued until the teeth can be kept in place by antagonism with the opposing teeth; or in case there is no such antagonism, a retaining appliance must be worn more or less constantly for a year, or even longer. The regulating appliance should be as simple in its construction as is possible to accomplish the purpose, so that both time and labor may be saved and the patient be able to attend to its removal and adjustment when it becomes necessary to cleanse it; this should frequently be done.

Teeth artificially regulated change position chiefly, if not entirely, by the double process of absorption from one side of the socket, followed by the slower process of ossific deposit on the opposite side. It is therefore essential to success that the tooth be retained in its new position, either by the other teeth or by mechanical appliance, until such deposit is formed. Many cases fail from a want of persistence on the part of patient or dentist.

How far and in what direction a tooth may be removed will depend partly upon the position of the apex of the root, partly upon the antagonism of the opposing teeth.

Cuspids growing out far upon the alveolar arch will usually be found to have short and curved roots. The attempt to move them might cause the curved apex to pierce the alveolus. Even when not curved, the root is short, and the regulated tooth will not possess that durability which is characteristic of the cuspids. It should always be borne in mind that in regulating the teeth the crown is the movable point, whilst the apex of the root is the fixed point, and must determine in great degree the extent and direction of motion.

Again, the natural or artificial movement of bicuspids backward to make room for front teeth may be aided or hindered by the opposing teeth. An upper bicuspid, for instance, once carried back, so that the posterior slope of the lower bicuspid strikes it, will retain its position or may be thrown even further back.

Upper incisors striking inside the lower, or lower incisors unnaturally prominent, may be regulated, and the opposing teeth will tend to keep them in their corrected position. But it will require long and patient use of the regulating apparatus to keep in place upper incisors which project outward, or lower incisors inclining inward.

In deciding upon the removal or extraction of an irregular tooth, it should not be forgotten that a tooth moved by mechanical appliance, especially if the change in position is considerable, will not prove as durable as if no movement had been necessary. Hence it may sometimes be advisable to extract irregular cuspids in cases where their correction requires much change in their position and that of the bicuspids, and the arch is completely and regularly filled by the remaining teeth.

In a case presented to the late Prof. Austen the superior arch was perfectly regular and closely filled, but both cuspids had come out above the arch. The cuspid roots were normal, and it seemed practicable to bring these teeth down into the places of the first bicuspids. But the four bicuspids were sound, and the first bicuspids gave very much the appearance of the natural arrangement. Hence, as in point of expression there would be no great gain and in point of durability a probable loss, it was not thought advisable to subject the patient to the tedious annoyance of regulation.

In describing the treatment of irregularity we shall notice the means by which some of its principal varieties may be remedied; otherwise, the application of the principles of treatment would not be well understood, since it must be varied to suit each individual case.

As a general rule, the sooner irregularity in the arrangement of the teeth is remedied the better; for the longer a tooth is allowed to occupy a wrong position, the more difficult will be its adjustment. The position of a tooth may sometimes be altered after the eighteenth, twentieth, or even the thirtieth year; but it is better not to delay the

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application of the proper means until so late a period. A change of this kind may be much more easily effected before the several parts of the osseous system have reached their full development, and while the formative process is in vigorous operation, than at a later period of life. The age of the subject, therefore, should always govern the practitioner in forming an opinion as to the practicability of correcting irregularity. Previously to the twentieth year the worst varieties of irregularity may in most cases be successfully treated.

The first thing claiming attention in the treatment is the removal of its causes. Whenever, therefore, the presence of any of the temporary teeth has given a false direction to one or more of the permanent, they should, as a general rule, be extracted, and the deviating teeth pressed several times a day with the finger in the direction they are to be moved. This, if the irregularity has been occasioned by the presence of a deciduous tooth, will generally be all that is required.

But when it is the result of narrowness of the jaw, either congenital or acquired, a permanent tooth on either side should be removed to make room for such as are improperly situated. All the teeth being sound and well formed, the second bicuspids are the teeth which should be extracted; but if, as is often the case, the first permanent molars are so much decayed as to render their preservation impracticable, or, at least, doubtful, these teeth should be removed in their stead. After the removal of the second bicuspids, the first, usually, very soon fall back into the places which they occupied, and furnish ample room for the cuspids and incisors. But if they fail to do this, they may be gradually forced back by inserting wedges of wood or rubber between them and the cuspids, or by means of a ligature of silk or rubber securely fastened to the first molar on each side, or by other proper appliances. These should be renewed every day until the desired result is produced.

The most frequent kind of irregularity resulting from narrowness of the jaw is the prominence of the cuspids. These teeth, with the exception of the second and third molars, are the last of the teeth of second dentition to be erupted, consequently they are more liable to be forced out of the arch than any others, especially when it is so much contracted as to be almost entirely filled before they make their appearance. The common practice in such cases was to remove the projecting teeth. But as the cuspids contribute more than any of the other teeth, except the incisors, to the beauty of the mouth, and can in almost every case be brought to their proper place, the practice is injudicious. Instead of removing these, a bicuspid should be extracted from each side. When the space between the lateral incisor and the bicuspid is equal to one-half the width of the crown of the cuspid the second bicuspid should be removed, but when it is less, the first should be taken out, because, although the crown of the latter may be carried far enough back after the removal of the former to admit the crown of the cuspid between it and the lateral incisor, the root of this tooth will remain in front and partly across the root of the first bicuspid, leaving a more or less prominent vertical ridge on the anterior part of the alveolar border, which, to some extent at least, acts as an irritant to the gums and periosteum.

As the incisors of the upper jaw are more conspicuous than those of the lower, and when well arranged contribute more to the beauty of the mouth, their preservation and regularity are of greater relative importance. Hence, the removal of a lateral incisor, when it is situated behind the dental arch, as is often done with a view to remedy the deformity produced by false position, is a practice which cannot be too strongly deprecated, provided sufficient space can be made for it between the cuspid and central incisor by the removal of a bicuspid from each side of the jaw.

Dr. Kingsley remarks that "cases are of frequent occurrence which show that a pair of any of the teeth in the mouth may be removed to correct an irregularity, excepting the canines of both jaws and the superior central incisors." "It would be an inconceivable case which would justify the extraction of the superior central incisors; but the upper lateral incisors and any pair of the lower incisors may be removed, in certain cases, without any serious detriment to the appearance of the mouth." "It is not necessary to the contour, symmetry, or harmony of the features that every one of the masticating organs should be retained in the mouth." "The *articulation* of masticating organs is of much more importance than their number, and a limited number of grinding teeth fitting closely on occlusion will be of far greater benefit to the individual than a mouthful of teeth with the articulation disturbed." "It is a disputed point as to which of the teeth behind the six front teeth can be best spared from the mouth." "If the sixth-year molars are badly decayed their removal would be indicated. If they were sound, and also the bicuspids, there might be no greater reason for their removal than either of the bicuspids. In fact, sound molars in the jaw are of more value as masticating organs than equally sound bicuspids." The same writer is also of the opinion that extraction of any teeth from a V-shaped jaw before it is widened would be likely to prove bad practice.

Many different forms of appliances are necessary in correcting an irregular arrangement of the teeth, as almost every case presents its own peculiarities. It is therefore not only impossible to describe every form of irregularity to which the teeth are subject, but also the forms of appliances necessary. The attention of the reader will, therefore, be directed to the treatment of the most common forms and the necessary appliances for their correction, modifications of which can be constructed according to the peculiarities presenting themselves. The most simple appliances for correcting irregularity consist of rings cut from rubber tubing and silk or rubber ligatures, which have their uses in the management of some of the easily manipulated cases. The value of such simple appliances, however, depends upon the skill exercised in applying and securing them. A simple band or ring cut from rubber tubing, and prevented from slipping up to and injuring the gum by means of waxed floss-silk tightly tied about the necks of the teeth, will answer for drawing two teeth, incisors for example, together, between which there is an unsightly space. A similar ring may be employed for correcting an irregular front tooth which projects beyond the arch.

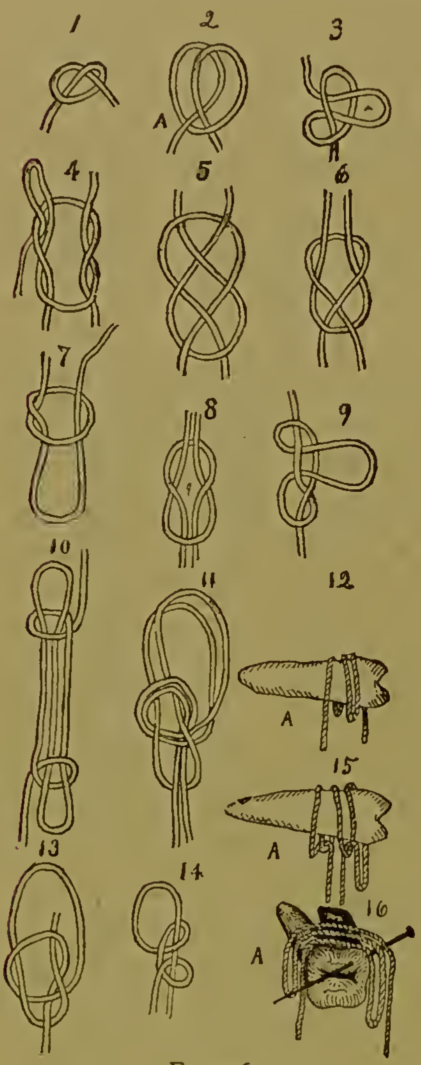


FIG. 165.

The following figures represent some of the most useful knots for applying silk ligatures :—

Fig. 165 represents 13 forms of the most useful knots: 1, thumb-knot; 2 (12, 15, 16), various stages of the clove-hitch; 3, drag-rope, or lever-hitch; 4, draw-knot; 5, garrick bend; 6, common or sheet-bend; 7, running-knot; 9, men's harness-hitch; 10, sheepshank; 11, double bowline-knot; 12, first stage of clove-hitch; 13, single bow-line-knot; 14, half-hitch; 15, second stage of clove-hitch.

In describing the treatment of irregularity we shall commence with an incisor occupying an oblique or transverse position across the alveolar ridge; so that the cutting edge of the tooth instead of being in a line with the arch forms an angle with it of from forty to ninety degrees. This variety of deviation is rarely met with in both centrals, but often occurs with one. Some dentists have recommended in cases of this kind, when the space between the adjoining central and lateral incisor is equal to the width of the deviating tooth, to turn the latter in its socket with a pair of forceps, or to extract and immediately replace it in its proper position. It is scarcely necessary to say that if a tooth is turned in its socket, without great care is exercised and the operation gradually performed, the vessels and nerves from which it derives nourishment and vitality are strangulated; hence, though its connection with the alveolus may be partially re-established, it will be liable to act as a morbid irritant and be subject to inflammation from comparatively slight causes.

The tooth, however, may be brought to its proper position, without incurring the risk of injury, by accurately fitting a gold ring or band with knobs on the labial and palatine sides; to each of these a ligature should be attached. Thus fastened to the ring, each end should be carried back, one on either side, in front and behind the arch and secured to the bicuspids, as represented in Fig. 166, so as to act constantly upon the irregular tooth. The ligatures should be renewed from day to day until the tooth assumes its proper position. Should the space not be sufficient to permit the use of the band the method practised by Mr. Tomes is shown in Fig. 167. A plate is fitted to the inside of the arch and a band carried in front and soldered to projections from the plate, which pass between the bicuspids. On each side of the irregular tooth a metallic dovetail is fastened and pieces of compressed wood inserted into them. The swelling of the wood gradually turns the tooth. In a few days the metal sockets will require to be changed in position, and in a few weeks the tooth may be thus brought nearly or quite to its natural place.

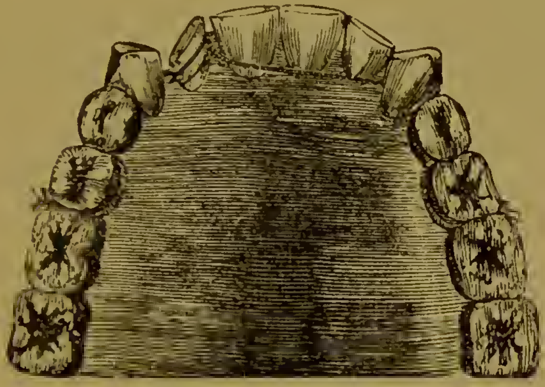


FIG. 166.

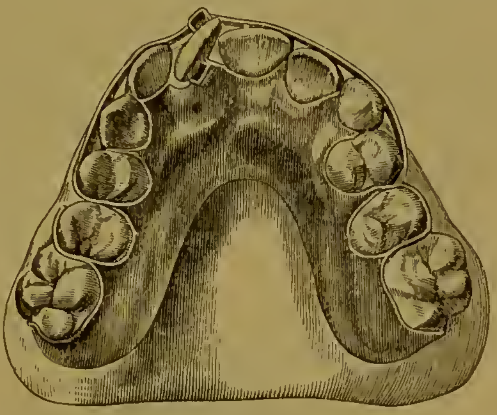


FIG. 167.

If the space permits, these two methods may be advantageously combined. Use the plate as in Fig. 167, with the inner dovetail, but for the long outside band substitute the band (Fig. 166) around the tooth, with a loop on the median side; from this pass an elastic ligature to a hook attached to the plate. The tooth is turned on its axis by the combined pull of the ligature and thrust of the wood.

For turning or twisting a tooth upon its axis, Dr. J. F. Flagg recommends the clove-hitch, Fig. 165^2, over which the ends of the ligatures are passed and then tied tightly with a surgeon's knot, which holds so firmly to the tooth that it will not slip; the ends are then carried to a rubber ring attached to a neighboring tooth, which by its elasticity keeps up a constant torsion force.

For rotating a single tooth as well as drawing out teeth that incline within the arch, the screws represented in Fig. 168 and designed by Dr. Farrar will be found as useful as any other means.

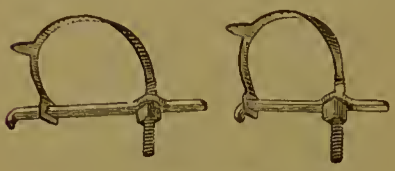


Fig. 168.

Before attempting to turn the deviating organ it should be ascertained if the aperture between the adjoining teeth is sufficient to admit of the operation. If not, it should be increased by the extraction of a bicuspid from each side of the jaw and moving the teeth in front of them backward until sufficient room is obtained. The time required to do this will vary from three to eight or ten weeks, depending upon the number of teeth to be acted on and the age of the patient. A sufficient space may sometimes be gained by pressing outward the adjoining teeth in cases where they fall within the normal curve of the arch. This may be done by the use of the "Coffin Split Plate," or by the "Norton-Talbot Regulating Springs," both of which appliances are described further on.

Fig. 169, 170, and 171 represent favorite devices of Dr. J. N. Farrar for rotating teeth,,the simplicity of which requires no further explanation except that it is constructed entirely of gold or platinum, and bound upon the tooth to be rotated by a slip-noose as thin as writing paper and about one-twelfth to one-fifteenth of an inch wide, which is tightened by means of a nut screwed against a small strip of plate resting against other teeth.

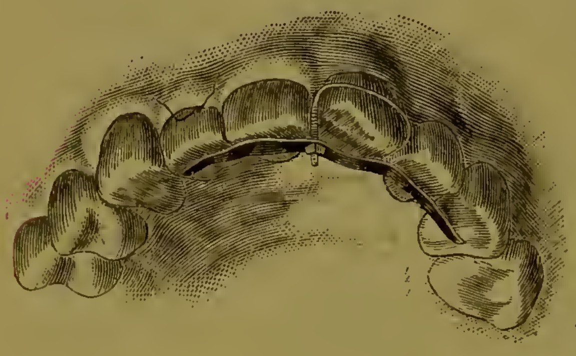


Fig. 169.

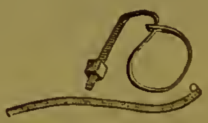


Fig. 170.

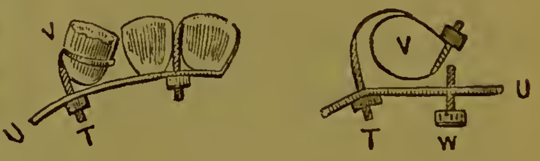


Fig. 171.

Irregular and protruding front teeth may be partially rotated and drawn into position by a very simple, but at the same time ingenious appliance devised by Dr. S. H. Guilford. Figs. 172, 173, 174, 175, and 176 represent two cases of the kind referred to and Dr. Guilford's appliance. According to Dr. Guilford's description, this appliance is made on a model of the teeth, and is constructed as follows: "A piece of gold backing cut an eighth of an inch wide, and of sufficient length to extend along and a trifle beyond the palatal surfaces of the centrals, is bent to conform as closely as possible to the lingual surfaces of these teeth, and forward so as to slightly clasp the disto-palatal angles as shown in *a*, Fig. 174. To this are soldered two strips cut from upper plate scrap, a little narrower than the first piece, and bent in the form of *b* and *c*, Fig. 174, respectively, which are sufficiently long to extend slightly over the anterior and posterior surfaces of the teeth. After being properly shaped to fit the model, their backs are soldered together, and, in turn, soldered to the part (*a*), as shown in Fig. 174. The only thing then to be done is to reduce with a file the thickness of the part *b*, *c*, which

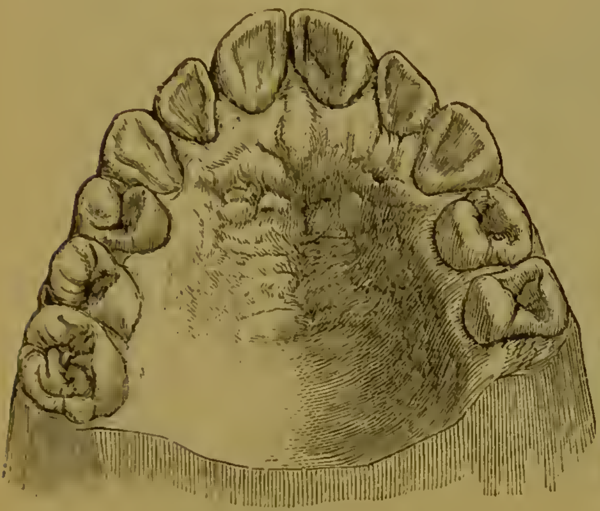


Fig. 172.

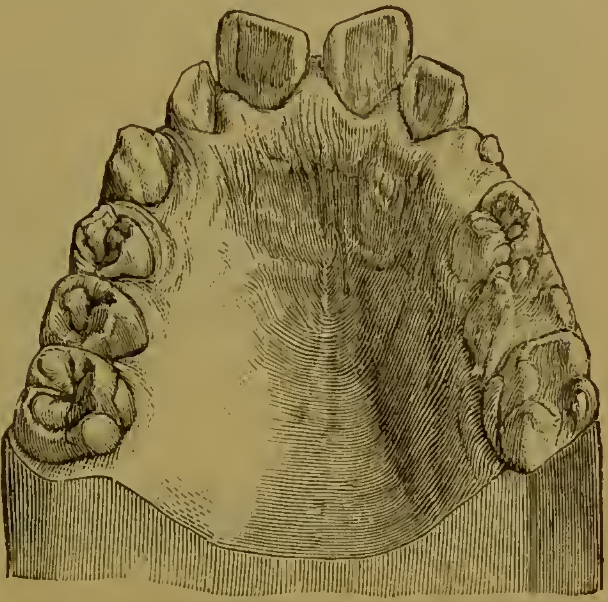


Fig. 173.

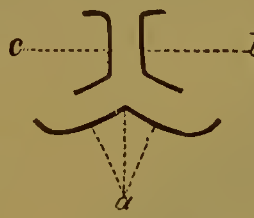


Fig. 174.

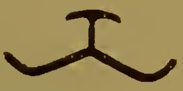


Fig. 175.

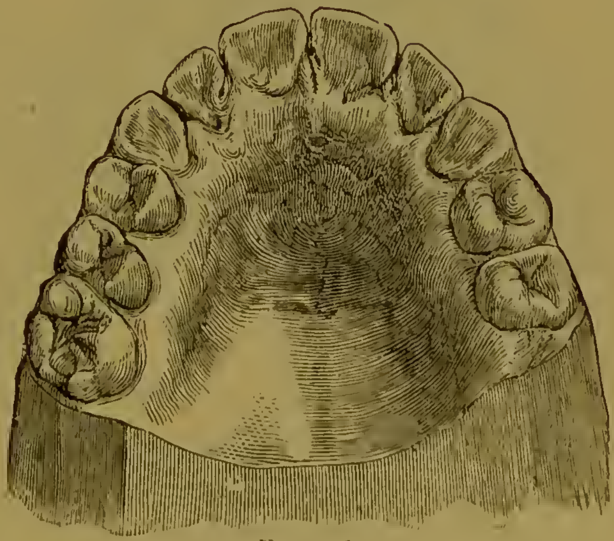


Fig. 176.

passes between the teeth, Fig. 175. Before applying such a fixture, it may be necessary to place a piece of wood between the teeth for a few hours, to separate them sufficiently to admit the appliance. The labial part of the apparatus should rest against the teeth just at or slightly above the most prominent part of their convexity, while the lingual portion should be near the gum (not quite touching it), and the slightly curved ends of this part will catch just above the little nodule usually found on the disto-palatal angle near the gum. When thus secured it cannot easily be displaced by the action of the lip or tongue. Bend the long palatal arms slightly toward the short labial ones daily, and spring it back into position on the teeth. The elasticity of the gold stiffened by the solder will do the work. To guard against its accidental loosening tie it to the tooth with a thread."

Fig. 177 represents an appliance designed by Dr. Kingsley for twisting the central incisors. After the arch was expanded, as it was a case of contracted arch, a vulcanite plate was required to retain the teeth in their spread condition, and its presence was made available for attachments for elastic ligatures. A small hook of gold wire was inserted opposite the canine teeth, and a little staple or loop of the same wire at the apex of the plate between the centrals. Previous to insertion a ring of rubber cut from tubing was caught over one hook, passed through the loop at the apex and caught on to the other hook. The plate was then introduced into the mouth and the elastic band drawn over each lateral incisor, as seen in the figure. The tendency of the elastic band to contract in a straight line operated only on the inverted corners of the centrals, and by this means the centrals were turned into their proper positions.

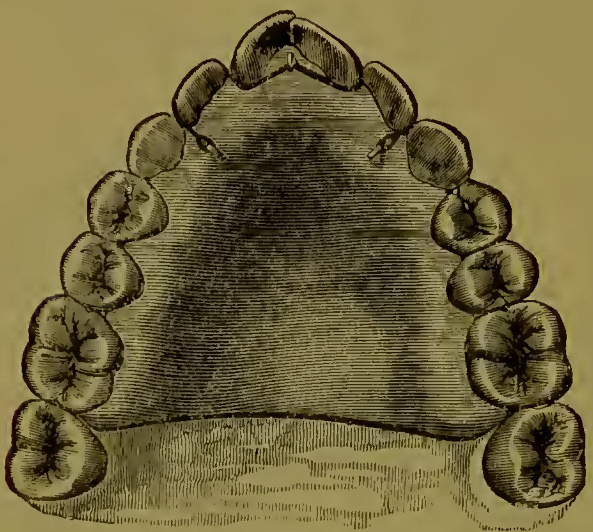


FIG. 177.

Figs. 178 and 179 represent a case of irregularity before and after treatment, where the overlapping central incisors were turned and a deviating lateral incisor forced outward by the appliances just described.

The operation known as "*torsion*," which has been recommended by Mr. Tomes, consists in forcibly turning a tooth in its cavity by grasping it near its neck with a pair of forceps, the beaks of which are guarded with chamois-skin or other substances, to prevent injury. Where the deviating tooth, such as an incisor, requires but one-fourth of a turn or twist, or less, this is accomplished by one operation; but where one-half turn is required several operations, after intervals of a few days, are necessary. The tooth is then secured in its new position by means of ligatures until a retaining plate is constructed and the necessary antiphlogistic treatment pursued. The danger of such an operation as torsion is the injury likely to occur to the vessels and nerves resulting in devitalization, and in no case should it be attempted until the root of the deviating tooth is fully formed and sufficient space exists for its reception.

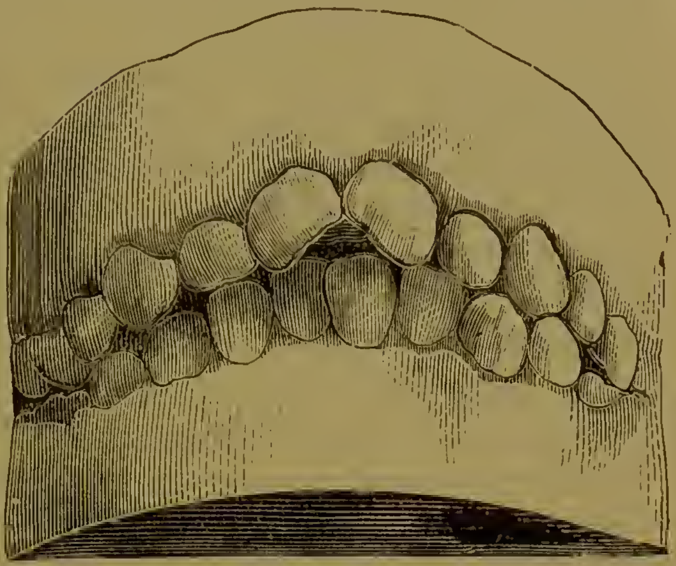


FIG. 178.

The use of vulcanized India-rubber is of great value in the correction of irregularities. The peculiar manipulations it requires will be found in another portion of this work; it is only necessary, therefore, in concluding this chapter, to briefly mention the properties which fit it for this important branch of dental practice.

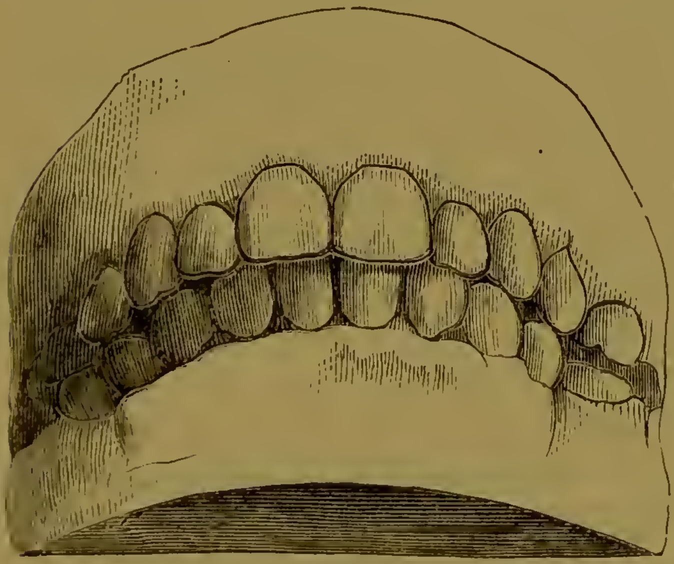


FIG. 179.

It admits of absolutely perfect adaptation to the teeth. If only a part of the crowns of the teeth require fitting, a wax impression will be sufficiently accurate. But if the gum and under-cut surfaces of the teeth are to be fitted, a plaster impression is necessary. Prof. Austen's method of taking plaster impressions in gutta-percha cups will enable a skillful operator to take an accurate impression of any mouth, however irregularly the teeth may be arranged.

A closely-fitting vulcanite plate can be worn with comfort; hence the patient is not tempted to remove it. It has no motion; hence does not wear the teeth or irritate the gums. Its firmness of adaptation makes it an excellent "fixed point" from which to make pressure or traction in any required direction upon the irregular teeth; the counter-pressure, being distributed all over the regular teeth, is not felt. When it is necessary to cap the molars, a layer of varying thickness should be carried over them all, to prevent the soreness caused by mastication upon any one tooth.

Any variety of appliances may be used in connection with the plate that the judgment of the operator suggests as best adapted to bring about the required change. The plastic nature of the crude material permits enlargement or extension in any direction, without the necessity of soldering, as in metallic plates, and with sufficient exactness.

Thus, prominences may be left behind teeth which are to be moved outward, in which may be made dovetails for the insertion of compressed wood, slits or holes for India-rubber, which makes more rapid pressure than the wood, or holes for the insertion of small screws. These screws may bear directly against the tooth, and be turned slightly each day or two. Or the portion of the plate next the tooth or teeth to be moved may be separated, with a delicate saw, from the plate; the ends of the screw or screws playing into this move the tooth or teeth by a broad bearing, which will, in certain cases, be better than the point of the screw.

Or a small piece of vulcanized rubber may be taken, one end fitting against a molar or bicuspid, and into the other end a screw thread cut to receive a delicate screw; on the head of this screw a second piece of rubber may be fitted against the tooth to be moved, so as to allow the screw to be turned without changing its position on the tooth. This combination forms a miniature jack-screw similar to those recommended some years since by Dr. Dwinelle, and will often be found useful. It may be used in combination with the rubber plate by attaching one end to the plate instead of resting it against a tooth.

If it is desired to move a tooth by the elasticity of a spring, a vulcanite plate is made to fit closely to the mouth and teeth; one end of a metal spring is fitted tightly into a groove cut in the plate, so that the free end shall bear with the requisite force against the tooth. The elastic slip or spring, when made of vulcanized rubber, can readily be bent by means of a warm burnisher, so as to press with greater or less force, as the case may demand. Fig. 180, taken from Mr. Tomes' work, will illustrate one variety of the application of metal springs on a vulcanite plate, in this case pressing outward and laterally the left central and right lateral incisors. This mode of making pressure will be found very useful. It acts steadily, is under control, and does not need renewal so often as the wedges of wood or rubber. What are known as seamless collars can also be employed for rotating teeth, as follows:—

"To rotate a central incisor, take a fine wire and wrap it around the tooth, close to but not under the gum, and cut the wire so that its ends exactly meet to measure the circumference of the tooth. Straighten the wire without stretching it; find its equal in length on the collar diagram, and select the medium width collar numbered under that line. Take a piece of thick gold plate, shape it like Fig. 181, and solder it to the collar as seen in Fig. 182, using only solder enough to unite the end of the lever, without flowing any solder over the collar to prevent it from fitting close on the tooth. Dry the tooth, smear its neck all around with oxyphosphate cement, and force the collar over the tooth so that the lever will be in position to be pulled by a ligature, or rubber ring, after the cement has become hard, which should take at least ten minutes. The applied fixture is shown by Fig. 183. A bar regulator that is to be anchored to molars or bicuspids may be likewise soldered to collars, which can then be cemented on the anchor teeth; or the bar may be adjustably connected with the collars, which are then fixed by cement on the teeth."

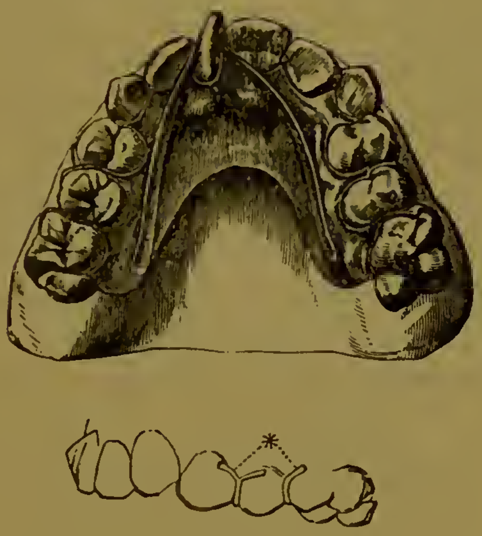


FIG. 180.

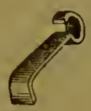


FIG. 181.

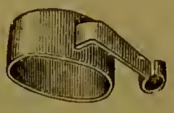


FIG. 182.

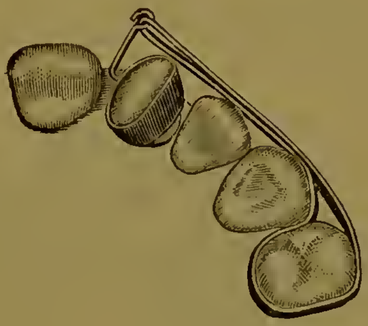


FIG. 183.

"Such fixed collars also serve as fulcra for jack-screws, the points of which will take on the metal of the collars so as not to slip, and yet leave the enamel uninjured. Other similar functions will be found available in the collars for regulating purposes."

Where ligatures are required, the vulcanite plate affords an easy means of attaching them in any desired position; passing them through holes and tying; looping them over projecting knobs of vulcanite, or over small metal hooks set in the plate; or stretching them through slits sawn in the plate.

If a band is to be carried for any purpose in front of the arch, it may be connected with the plate on the inside of the arch, through any spaces occurring between the bicuspids or molars; if there are no such spaces, or if they are to be closed up in the process of regulation, the cap which is often required to pass over the molars will connect the two. But the outside band is not often necessary. The inside plate is less awkward to the patient; it is out of sight; and almost, if not quite, every required movement can be obtained from it.

Where the irregularity consists in some of the teeth projecting while others incline inward, such a case can be advantageously treated by the use of a vulcanite plate, the various stages progressing nearly at the same time. The impression in this case to be taken in plaster; the plate capping the second molars; first molars and first bicuspids carried outward by wooden or elastic wedges, or by a double spring of vulcanite fastened to the plate opposite each space of the extracted second bicuspids; the left central and right lateral carried out by wedges or screws; the right central and left lateral brought in by ligatures looped over hooks in the plate. At the completion of the work a new impression to be taken and a plate worn until the teeth become firmly fixed, the use of such a retaining plate preventing a return of the teeth to their old positions.

Ligatures in connection with a vulcanite plate can also be employed for drawing irregular projecting front teeth to their normal positions, after the removal of posterior teeth (the second right and left bicuspids, for example), to afford the requisite space. Fig. 184 represents a case of torsion and retraction of the central incisors, with pins imbedded in the vulcanite plate for the attachment of the ends of the ligature.

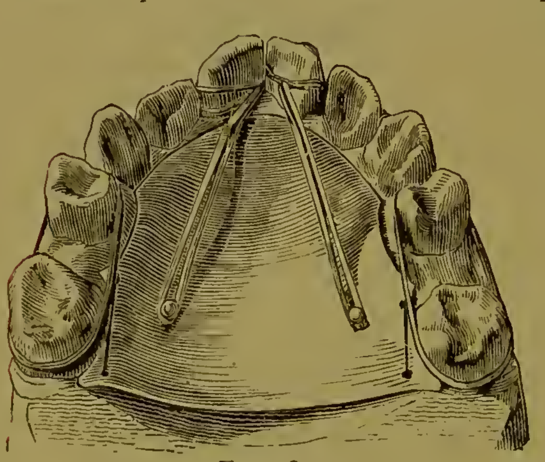


FIG. 184.

Studs of vulcanized rubber or celluloid, Figs. 185, 186, 187, 188, can be attached to rubber plates for the support of elastic rings, and moved from one position to another, as suggested by Dr. S. J. Shaw.

The late Prof. J. H. McQuillen recommended a strip of thick gold plate, similar to what is used for clasps, and curved to suit the arch, and so applied by means of rubber ligatures or rings as to draw forward irregular teeth. The ends of the bar are screwed to the bicuspid or molar tooth on either side, and the rubber ligatures or rings pass over the dovetail-shaped parts and the irregular teeth.

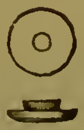


FIG. 185.

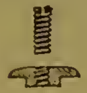


FIG. 186.

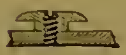


FIG. 187.

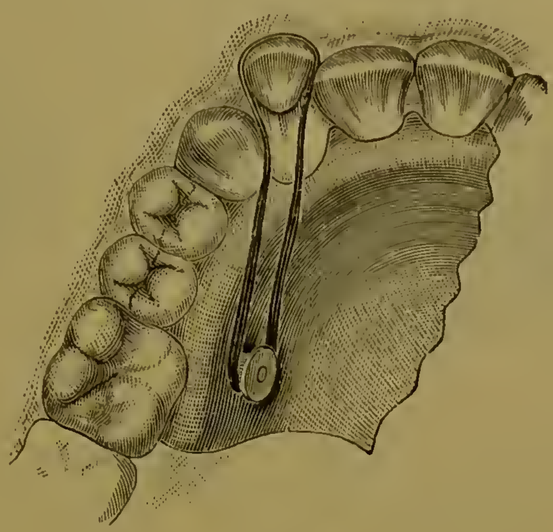


FIG. 188.

Fig. 189 represents portions of metallic bars, *a* and *b*, with holes and slits for elastic ligatures or rings; *c e f*, portions of bars with hooks and prominences for ligatures; *d*, plate, with holes for ligatúres (Farrar).

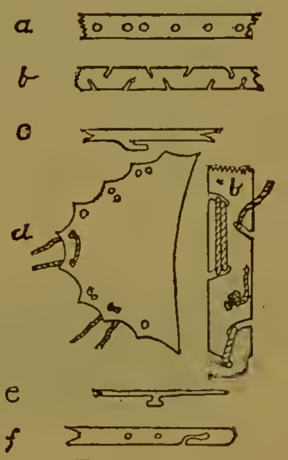


FIG. 189.

Where the irregularity consists in one or more of the superior front teeth shutting within the inferior teeth various appliances have been recommended, the oldest, perhaps, being the grooved plate of Duval, and inclined plane of Catalan, which consisted of a simple circular bar or plate of gold, passing in front of the teeth from the first molar on one side to the first molar on the other, to which the inclined plane was soldered.

In the application of this principle for the correction of irregularity the author has been in the habit of constructing the apparatus somewhat differently. With a metallic die and counter-dies, he has a plate of gold struck up over all the teeth, when practicable, as far back as the first or second molar, completely encasing them and the alveolar ridge. An encasement of this sort (Fig. 190) possesses greater stability than can be obtained for an appliance like the one invented by Catalan. The inclined plane represented by Fig. 190 can be more conveniently constructed of vulcanized rubber, which possesses advantages over metal for such an appliance.

If considerable time is required for the wearing of such an appliance as an inclined plane, injury may result, as the masticating teeth are prone to elongate and the proper articulation of the teeth be impaired; again, if the patient refuses to press the deviating teeth, on account of their sensitive condition while moving upon the inclined plane, the result desired will not be accomplished.

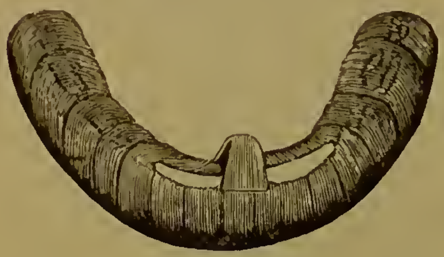


FIG. 190.

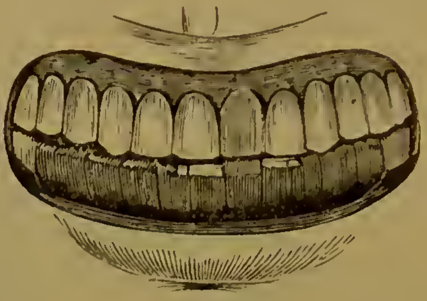


FIG. 191.

In Fig. 192 the letters A and B show a combination of an inclined plane with elastic ligatures, designed by Dr. N. W. Kingsley, to correct an irregularity of both upper and lower incisors, and the same apparatus was used as a retaining plate when the change was completed.

Two things are necessary in the treatment of this form of irregularity; first, to prevent the upper and lower teeth from coming entirely together by placing between them some hard substance, so that the overlapping incisors may not interfere with the necessary outward movement. The second is the application of some fixture that will exert a constant and steady pressure upon the deviating teeth until they pass those of the lower jaw.

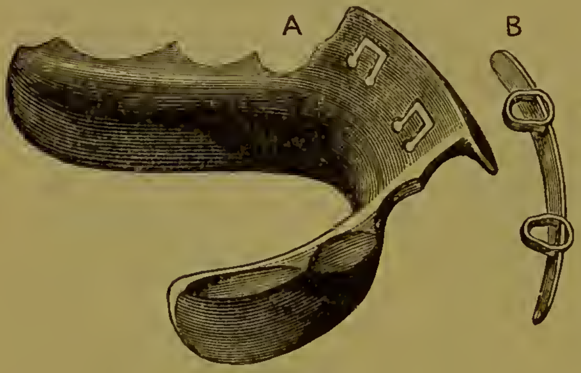


FIG. 192.

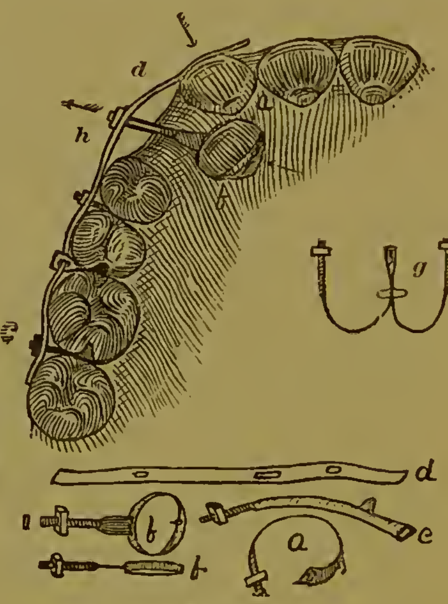


FIG. 193.

Fig. 193 represents another appliance of Dr. Farrar for correcting a form of irregularity where the teeth incline to the inside of the arch. The bar (*d*), in Fig. 193, is made of thick plate, about one-eighth of an inch wide, and is secured at one end (*c*) to a molar or bicuspid (or both) by means of a clamp-band (*a c* or *g*), while the other extremity rests upon a lateral incisor. This forms a bridge of the bar, which is pierced midway by an oblong hole, through which is passed a flat screw (*b b*), made by filing two sides, which prevents its turning, one end of which is soldered to a thin plate (or it may be hammered thin) at the free extremity of which is soldered a thin band (*b b*), which fits tightly around the crown of the cuspid to be moved. To prevent the band from slipping a metallic pin-point may be soldered on its inside, to fit into a little hole drilled into the tooth (or the band may be attached to the crown by the oxychlorid or oxyphosphate of zinc preparations and no hole drilled into the tooth). A nut (*h*) is then tightened, which draws the cuspid into position and at the same time forces the lateral incisor (which, in the case represented by the cut, is projecting) inward.

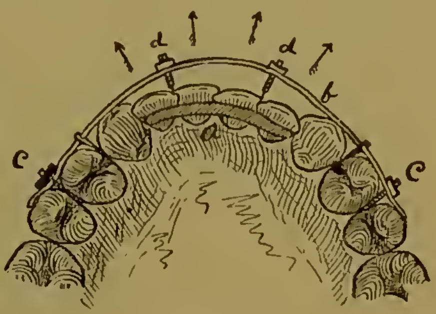


FIG. 194.

Fig. 194 represents another appliance designed by Dr. Farrar for drawing irregular front teeth outward, which needs no explanation.

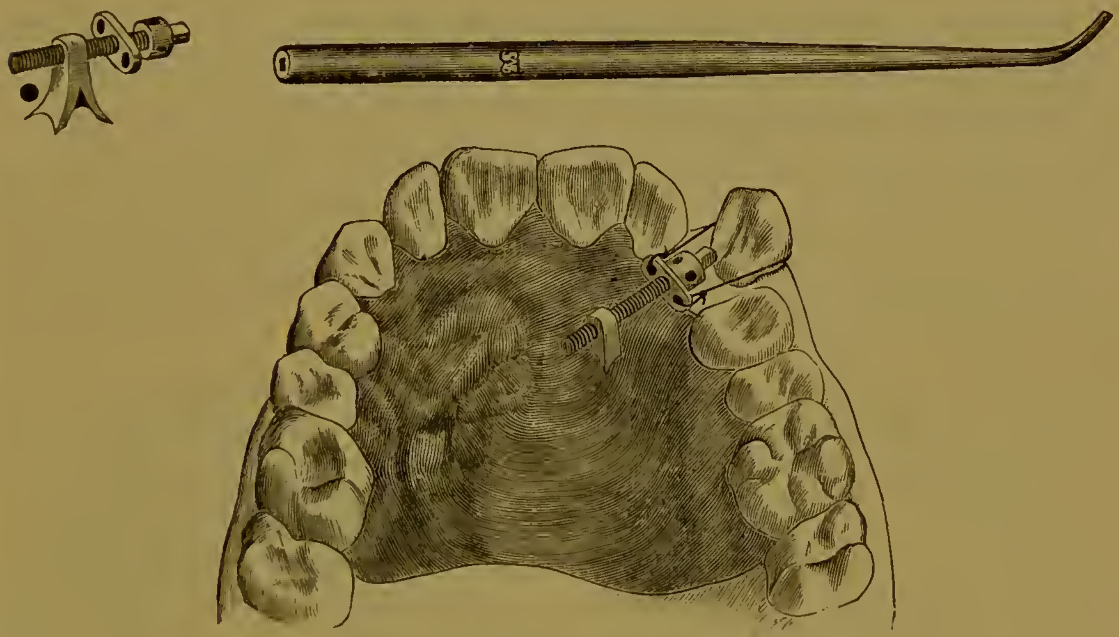


FIG. 195.

For drawing irregular projecting teeth, such as canines, into position, the following appliance of Dr. F. H. Lee, which was designed as an improvement on a somewhat similar appliance designed by Dr. Littig, answers the purpose admirably:—

The Pull-back Jack-screw's special use is for drawing in obstinate canines which have erupted outside of the line of the arch, but it will work with equal satisfaction on any of the other teeth.

The post or nut is set in position and held by vulcanizing into a rubber plate fitting the mouth as shown in the cut (Fig. 195); the screw-bolt is then placed through the post and a wire or ligature (wire preferred) is passed around the tooth, the ends being secured to the holes in the cross-head or swivel-block. The wire is then tightened from time to time as the tooth is brought to its place. To prevent the plate from being moved out of position by the strain upon it, it should be fastened to the teeth of the arch.

Figs. 196, 197, and 198 represent a form of irregularity consisting of the misplacement of the superior canines and lateral incisors, and the appliance designed by Dr. Joseph Richardson for correcting it, the principle of which was suggested a number of years ago by Dr. Redman.

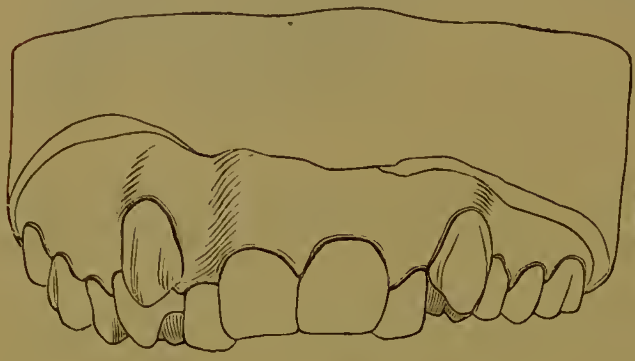


FIG. 196.

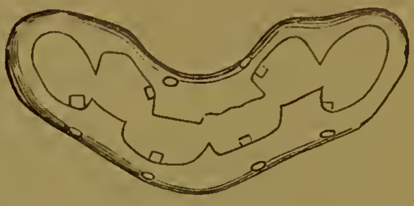


FIG. 197.

In addition to the malplacement of the lateral incisors and canines there was some lateral contraction of the arch. After the extraction of the first bicuspids a narrow band of vulcanized rubber (Fig. 198) was constructed, embracing the six anterior teeth. Pressure was made upon the misplaced teeth by means of wooden pegs inserted in holes drilled through the band at such points as were indicated by the direction in which it was desired the teeth should take. The pegs rested against the posterior mesial angles of the lateral incisors in such a way as to force them outward and backward, while those inserted into the opposite or labial portion of the band carried the canines backward and inward. These pegs projected but slightly at first and were lengthened from time to time as the teeth moved.

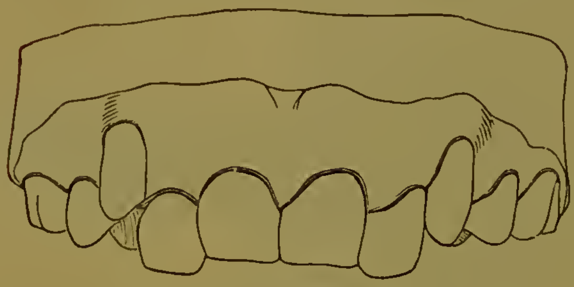


FIG. 198.

What is known as the "Lee-Bennett jack-screw" is an appliance suggested by Dr. G. W. Bennett (Fig. 199). It combines a swiveled jack-screw with the forked post-nut of Dr. Lee's Pull-back (Fig. 195), so that any tooth may be pushed outward into line, as shown by the cut. On occasion both devices may be fixed in the same plate and be simultaneously operated, the Lee to pull back one tooth and the Lee-Bennett to push out another. Both of the operating screws may be turned by the same lever.

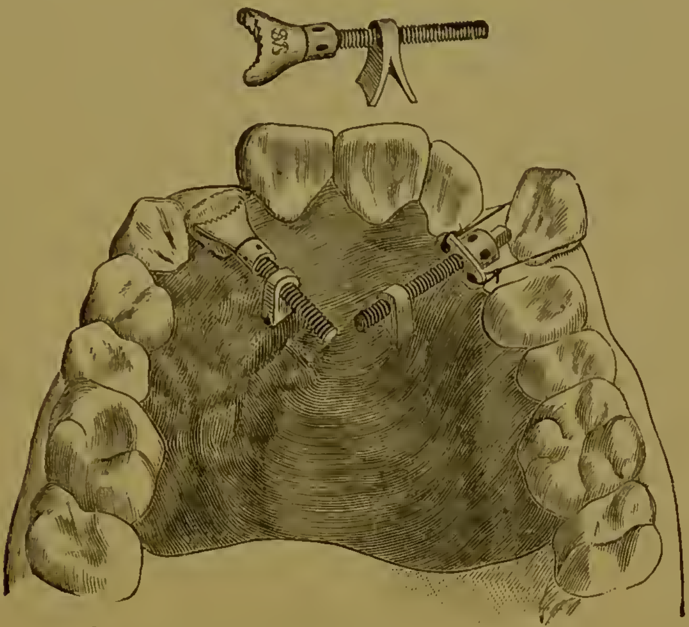


FIG. 199.

Figs. 200, 201, 202, represent a simple yet effective appliance suggested by Dr. E. S. Talbot for forcing out a tooth situated inside the arch, and which is described as follows :—

Fig. 200 represents a second inferior bicuspid within the arch, and the appliance, which consists of a thin, narrow, close-fitting vulcanite plate, with a hole drilled through its middle, opposite the centre of the tooth to be moved. In the other side is another hole, but not drilled quite through the plate. Fig. 201 represents a spring made of piano-wire, having a single coil, *A*, with the ends of its arms bent at a right angle. One of these ends, *C*, is cut short to enter the corresponding hole in the plate, and the other end, *B*, is left long

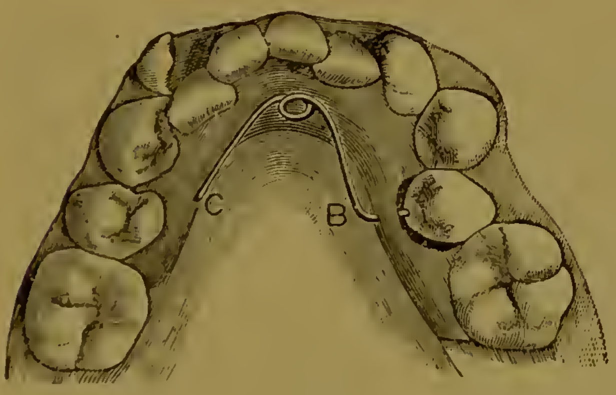


FIG. 200.

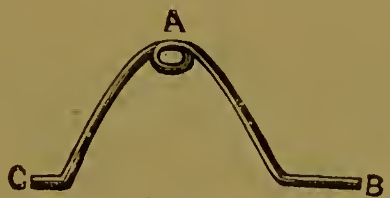


FIG. 201.

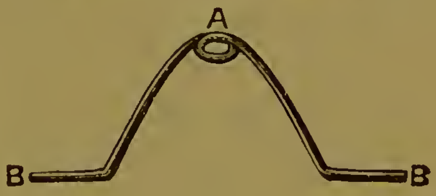


FIG. 202.

enough to go through the plate and press upon the lingual surface of the irregular bicuspid, leaving a full eighth of an inch between that arm of the spring and the plate, as is shown in Fig. 200, which represents the spring in position. The plate and spring being separate can be readily removed for cleansing and to increase the power by spreading the arms of the spring. Fig. 202 represents a spring for the same appliance, having two long ends, *B*, *B*, which are designed for a case where two such teeth are to be likewise moved in opposite directions; the two holes in this case to be drilled entirely through the plate, so that the ends of the springs can be made to press against the lingual surfaces of the two deviating teeth.

Dr. Richardson also designed the following appliance, represented by Fig. 203, for shortening teeth elongated during the treatment for irregularity.

It consists of a plate affording fixed points of resistance and having clasps attached and pinned to the centrals with wooden pegs resting against their anterior and the plate against their posterior surfaces, as represented in Fig. 203. To this plate firm elastic cords were attached, stretching across the openings for the elongated teeth. When this plate was pressed firmly to its place upon the teeth and held securely by the means already referred to, the contractile force of the cords produced the necessary shortening of the elongated teeth. Fig. 198 represents the elongated laterals, as shown in Fig. 204, in their proper positions.

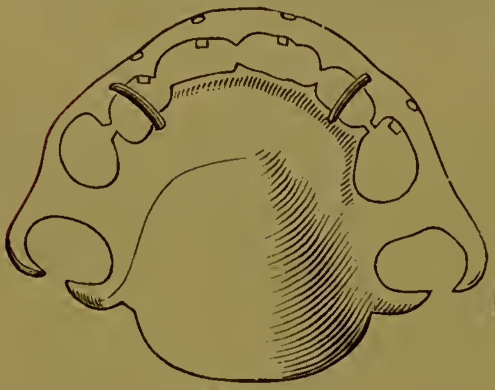


FIG. 203.

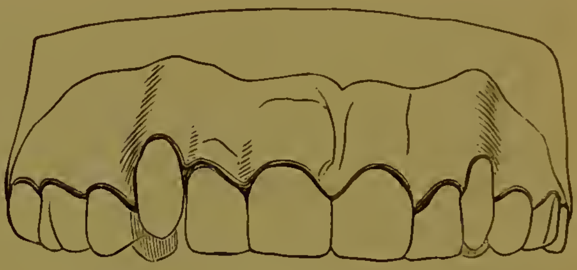


FIG. 204.

A system of regulating teeth, designed by Dr. Jno. J. R. Patrick, is simple and also effectual, and differs from any heretofore referred to. No cast of the mouth is required, and the appliances can be readily cleansed, and may be used for an indefinite number of times. The power employed is the elasticity of a bow-spring (see Fig. 205), which consists of a half-round gold wire and platinum bar (A A), curved to correspond with the shape of the arch, having upon it a number of sliding rings, by means of which anchorage is secured and attachment made to the teeth to be moved. The bar is bent with its flat surface inward, and is of sufficient length to allow its ends to rest gently on the external lateral surfaces of the first and second molars as desired. The slides are fitted accurately, so as to move steadily. Two of these, which are made longer for the purpose, are used to secure anchorage by soldering to their inner surfaces thin gold bands (B B), previously fitted to the teeth selected. The bar is held in position by set-screws (C C) passing through them. Small buttons are soldered to their external surfaces, through which the screws pass, to give them greater purchase. To the smaller slides the different appliances for moving teeth are attached, as wedges, hooks, V-bars, loops, and bands (D E F G H I), of various sizes and shapes, as required. The apparatus acts as a lever, of which the power is the elasticity of the bow-spring, the fulcrums the points used for anchorage, and the resistance the tooth or teeth to be moved. If these are outside the arch the bow-spring is adjusted so that its flat surface touches all of the projecting teeth, and is firmly set with the set-screws. The wedges are then forced together between the teeth to be moved and the bar; should the wedges cease to act before the teeth are properly placed, the set-screws are loosened, the wedges separated, and the bar taken up until its inner surface is again pressed against the projecting teeth, when it is again set firmly, and the wedges are again brought into play. To move teeth outward the elasticity of the bow-spring is made to draw upon them by means of the proper appliance. Rubber bands or ligatures may be made useful auxiliaries. This appliance can be used on either jaw. Should the bar at any time exhibit a tendency to slip toward the gum, it can be held in place by snapping one of the slides provided with a hook over the cutting edge of a tooth.

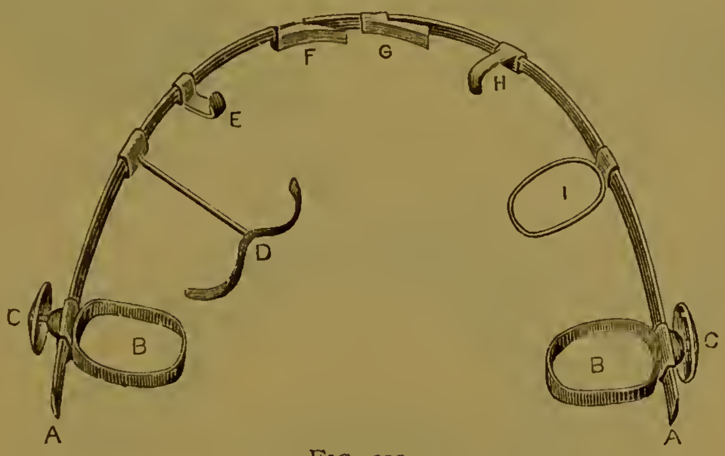


FIG. 205.

What are denominated "Yoke Regulators" are designed for use with Dr. Patrick's appliance. The yokes can be immediately fixed upon the teeth, and the manner of applying them is described as follows:—

The bow is to be passed from behind and between the teeth, however close together these may be. The coupler is then put over the bow ends, a nut placed in the end of the key and carried to place on the bow. When the nuts have been screwed on, if the bow ends project they can be dressed off with a corundum point or be covered by a section of small rubber tubing stretched from nut to nut, or be wound with ligature silk.

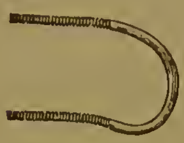


FIG. 206.
MOLAR BOW, A.

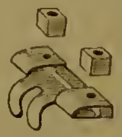


FIG. 207.
MOLAR COUPLER.

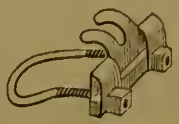


FIG. 208.
MOLAR YOKE.

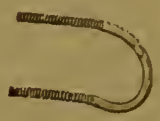


FIG. 209.
BICUSPID BOW, D

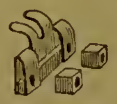


FIG. 210.—BICUSPID COUPLER.

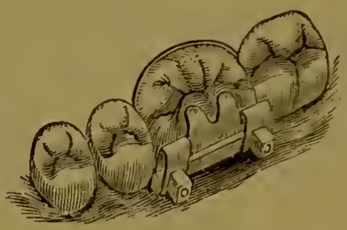


FIG. 211.—MOLAR YOKE IN PLACE AS AN ANCHORAGE FOR A SPRING OR RUBBER RING OR LIGATURE.

Figs. 206, 207, 208, 209, 210, 211, and 212 represent these yokes, bows, couplers, and their application to Patrick's bow-spring.

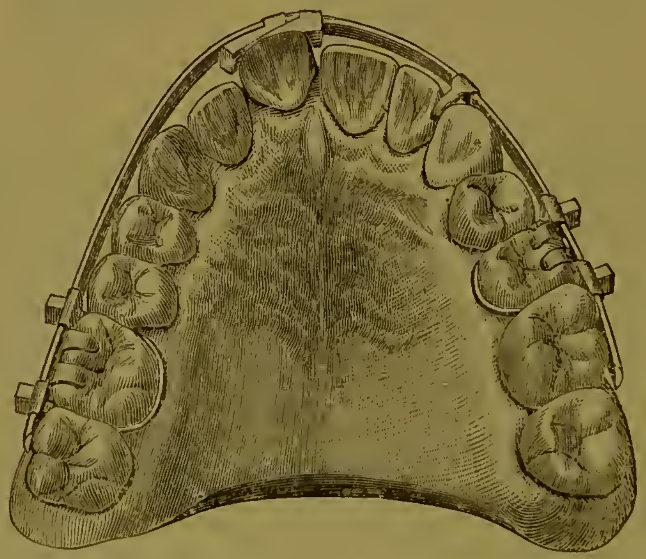


FIG. 212.—MOLAR AND BICUSPID YOKE REGULATORS WITH PATRICK'S BOW-SPRING, WEDGES, AND HOOK IN PLACE.

As comparatively few cases of irregularity occur which in their treatment do not require expansion of the arch, a number of appliances have been designed to accomplish such an object, such as a hinged metallic plate, the jack-screws, either by direct force or acting on split plates.

One of the most satisfactory appliances, however, for expanding the arch is the invention of Dr. Coffin, of London, Eng., which is represented by Figs. 213, 214. It consists of a thin vulcanite plate capping some or all of the bicuspids and molars and fitting the palatal or lingual surfaces of the anterior teeth, but divided along the median line into two distinct halves, connected, however, by a steel-wire spring, so arranged that, while guiding and limiting the relative motion of the two halves of the plate, its tension exerted between them may be perfectly varied in direction and magnitude. The impression of the mouth should be obtained with gutta-percha, as it is elastic, and by its slight contraction in cooling affords a tightly-fitting plate, which, however, is not inserted in the mouth until it is divided.

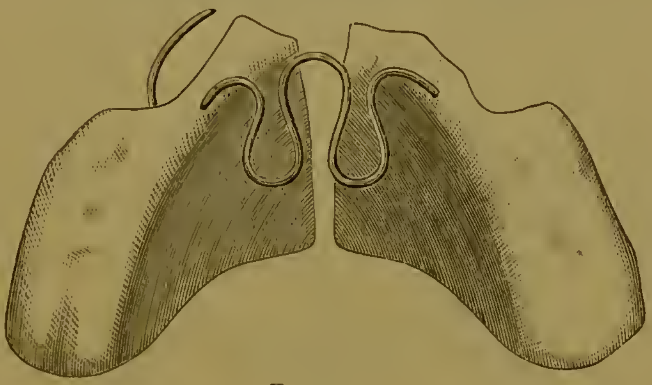


FIG. 213.

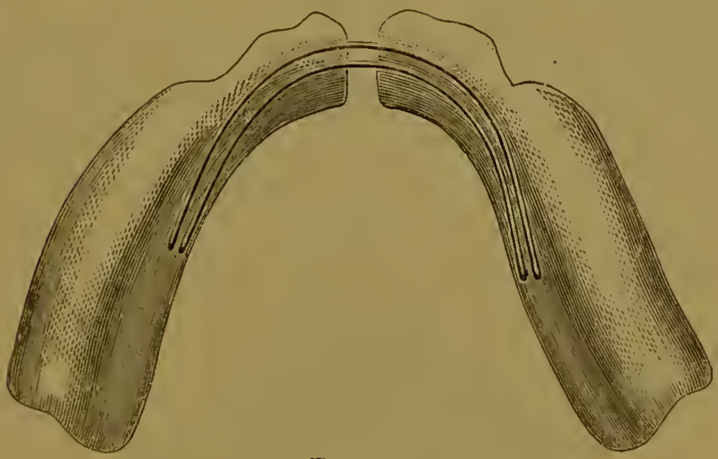


FIG. 214.

Figs. 213 and 214 are typical appliances for the upper and lower jaws. The wire in Fig. 213 shows the form best adapted for expanding the anterior portion of the arch; that in Fig. 214 the form adapted to enlarging the posterior portion. The additional wire on the left of Fig. 213 was used, in the case above mentioned, to force the lateral incisor outward.

The steel spring is made of pianoforte wire, and is of the form shown in Fig. 215. To construct the spring two pairs of pliers are necessary and a pair of clasp benders. After cutting the proper length of wire, from one to two and a half inches in average cases, the wire being of a diameter between three- and four-hundredths of an inch (about 0.035 inch), it should be bent first in the centre and then back on each side, with the clasp-benders, holding it with the pliers, and thus giving the spring (as a serviceable form) the shape of a three- or five-curved serpentine figure, like a rounded capital W. It should also be bent to fit as nearly as possible the palatal surface of an upper model or the lingual surface of a lower model, and its ends should be flattened and roughened, without being softened by heat, for half an inch from the extremities. The plate being modeled in wax, the spring is placed on the surface, with its ends buried within, and when removed by the counterpart, protected from the rubber by tin-foil before packing. In making the spring the flattened ends should be coated with tin ; some are in the habit of coating over the entire spring, but this is not necessary, as the wire after it is worn becomes discolored with a polished appearance. Some recommend the insertion of a small piece of zinc in contact with each of the ends of the wire, to prevent oxidation. Old pianoforte wire is considered to be the best for these springs. The plate, after being vulcanized, is finished in the usual manner, and is then divided with a fine saw, the edges and corners of the cleft being made round and smooth. It is recommended to have the patient wear the plate in the mouth for a day or two, to first eliminate any causes of irritation not due to its expansive action, before the tension is made by opening the spring. The patient can be instructed to increase the tension from time to time by slightly pulling apart the two halves of the plate and replacing it in the mouth.

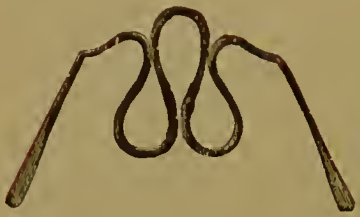


FIG. 215.

Figs. 216 and 217 represent modifications of the Coffin plate used for spreading the arch anteriorly and posteriorly, and by which the force is distributed over considerable surface.

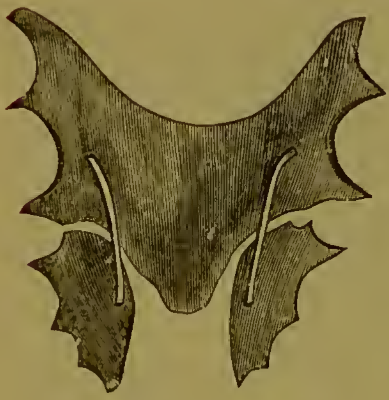


FIG. 216.

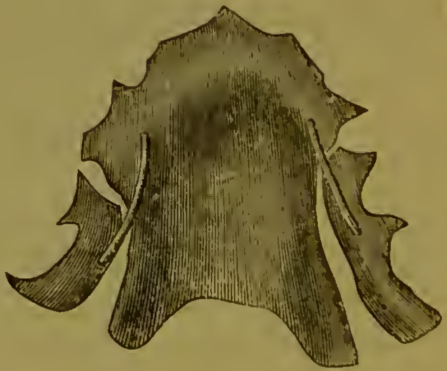


FIG. 217.

Fig. 218 represents a slit plate and springs for pressing outward bicuspids and molars.

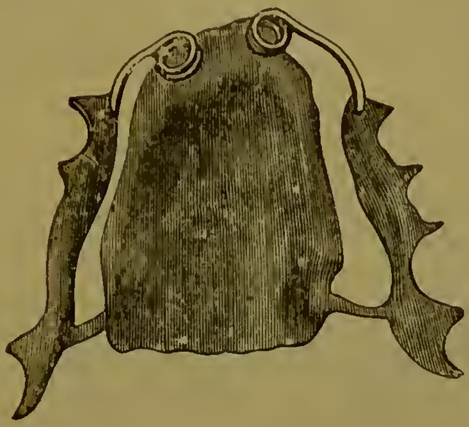


FIG. 218.

Another very satisfactory appliance for expanding either of the dental arches is the Talbot regulating spring, represented by Figs. 219, 220, 221, and 222.

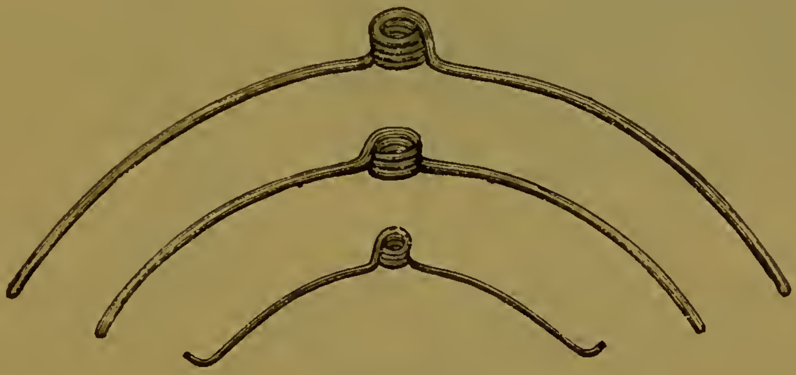


FIG. 219.

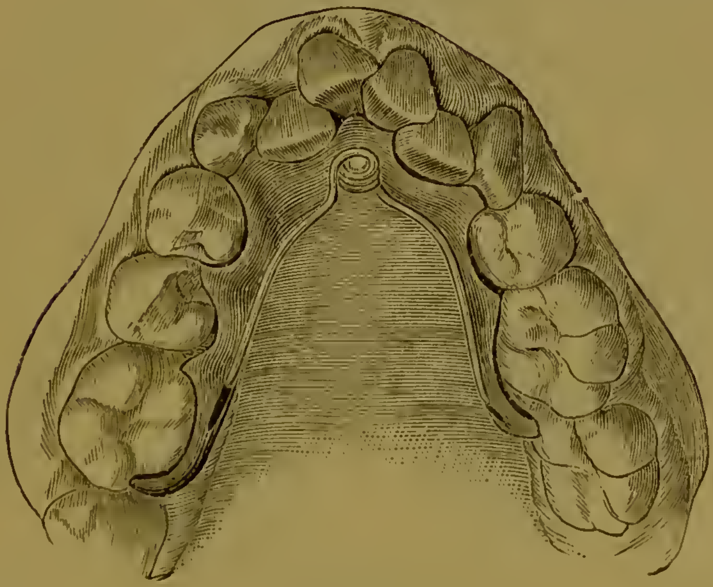


FIG. 220.

On an accurate plaster model of the case to be regulated a thin, narrow vulcanite plate is formed, with a short vertical post fixed, either before vulcanizing or afterward, by drilling centrally in the plate on the median line. By means of a wheel-bur, grooves or slots are cut in the sides of the plate to receive the ends of the spring and prevent its displacement after the coil has been placed on the post. The tension of the spring can be changed by bending its arms outward or inward. In the other cases grooves may be cut into the anterior and posterior parts of the plate, to correspond with and receive the points *b b* and *c c*, Fig. 222, and holes drilled at these points and the wire tied to the rubber plate. To move the anterior teeth with the greatest force the arms can be so adjusted that the pressure exerted is greatest on the anterior parts of the plate. These springs, connected with split-rubber plates, can also be utilized for pressing outward bicuspid and molar teeth. They can also be employed in connection with platinum bands or collars fitted about the necks, to press deviating teeth outward, Figs. 223 and 224. The collars are attached to the teeth by oxyphosphate of zinc, after a hole is drilled in the side of each, and the spring is bent into form and the ends turned at a sharp angle so as to enter the holes in the collars. These springs can also be used for pressing out the central incisors when they shut within the inferior front teeth. A rubber plate is made to fit the mouth as

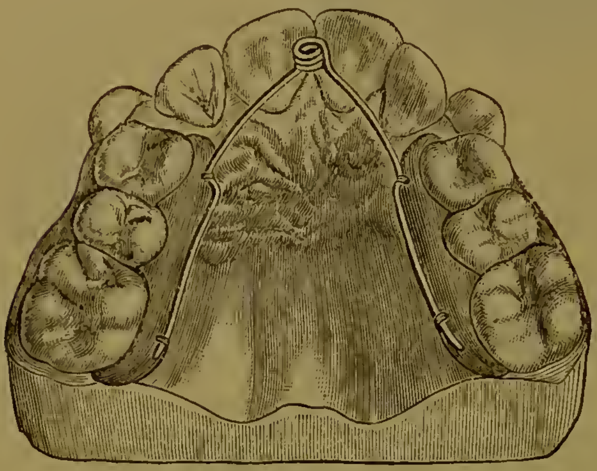


FIG. 221.

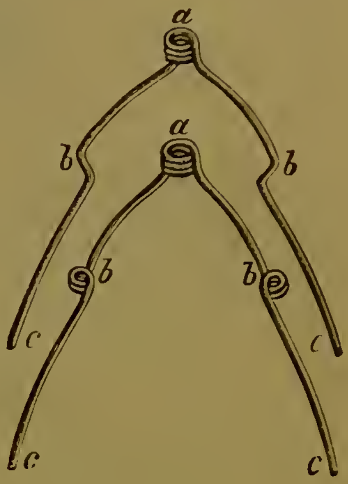


FIG. 222.

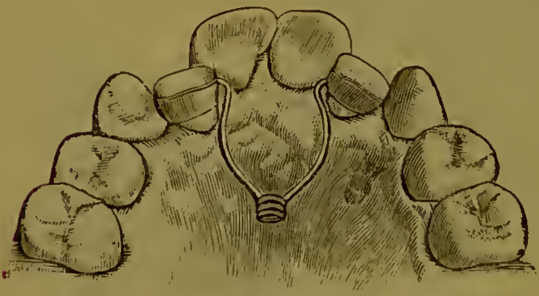


FIG. 223.

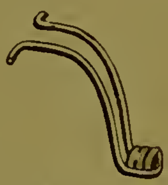


FIG. 224.

shown in Fig. 225, and two of these springs are vulcanized into it at the lateral incisor region. The arms are turned into loops at the extremities to secure a ligature. When the plate is adjusted the arms

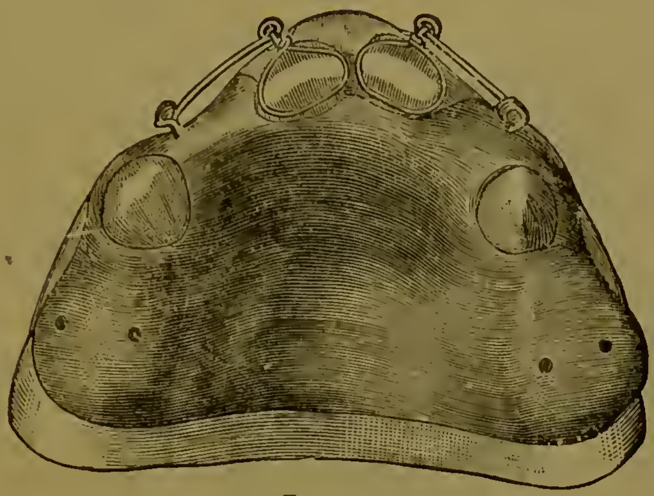


FIG. 225.

are bent horizontally and brought in close proximity to the labial surfaces of the deviating central incisors, and securely tied.

Fig. 226 represents appliances of Dr. Farrar's to move irregular

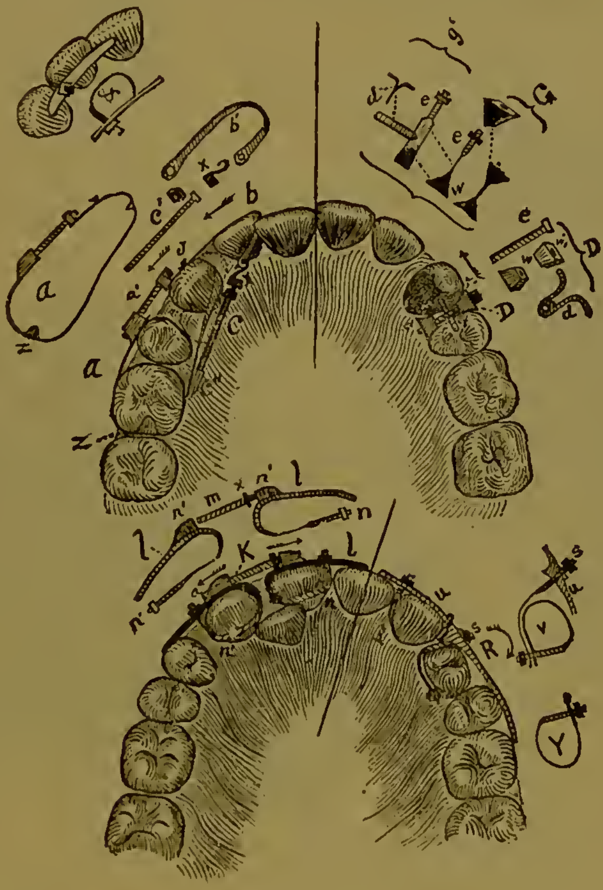


FIG. 226.

teeth—the first to draw teeth together and the second to separate irregular teeth in making space for another.

Fig. 227 represents an appliance, also of Dr. Farrar's, in position for drawing a cuspid toward a second bicuspid, after a first bicuspid has been extracted.

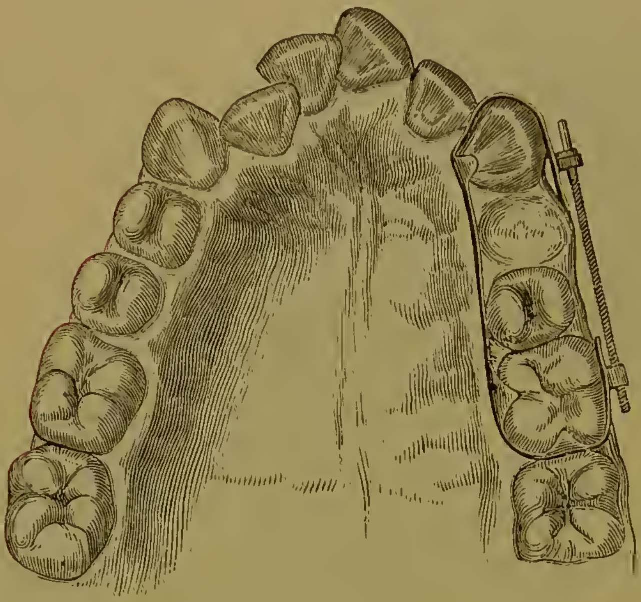


FIG. 227.

For moving a projecting incisor or cuspid backward, a gold spiral spring was formerly employed. It was found to be more efficient than a ligature of silk, inasmuch as it kept up a constant traction upon the deviating tooth. But it is objectionable on account of the annoyance it causes the patient. A ligature of rubber is far preferable, and this material is now very generally employed in the treatment of every description of irregularity in which simple appliances are required. The difficulty of tying India rubber ligatures is obviated by the use of several sizes of delicate elastic tubing (French manufacture), from which sections may be cut, more or less thick, according to the required length and power of the ligature. Each strip becomes thus an endless band, which may be readily passed from one tooth to another or to a hook on the plate.

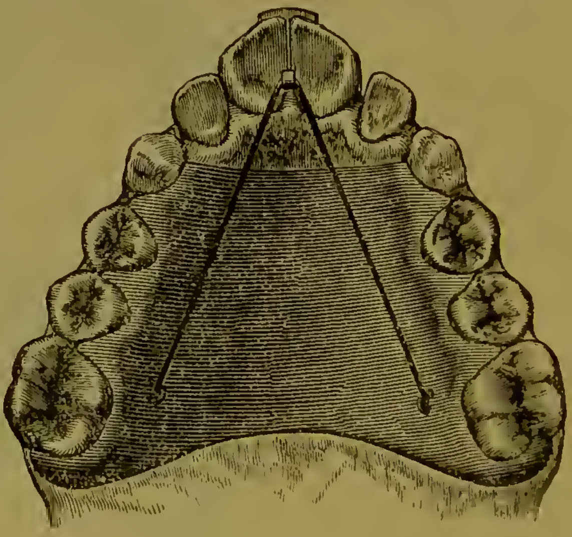


FIG. 228.

Where the superior central incisors project beyond the inferior so much as to give a pointed appearance to the lip, Dr. Kingsley recommends the following regulating appliance (Fig. 228): a rubber plate fitting the roof of the mouth is constructed on a plaster model, taken from a plaster impression, in the same manner as any other vulcanized rubber plate would be made. This plate, which is made as delicate as strength and durability will permit, is cut away opposite the irregular incisors, so that there may be room for these to be pressed in. The pressure, which is brought to bear in such a manner as not only to move these incisors, but act more or less upon the whole arch, is made by means of a very simple contrivance, such as a piece of gold, formed in the shape of a T, about a quarter of an inch in length, and with a staple or ring at the bottom of the upright portion of the T, through which a ligature may be passed. This ligature is a rubber ring, cut from a piece of small rubber tubing, and is passed through the eyelet in the T and then attached to the plate, reaching directly to the second molars on either side.

The plate being introduced into the mouth, the T is brought forward and passed between the central incisors, so that the cross-bar of the T is brought to bear upon their labial surfaces. If the incisors are in close contact, space is made for the gold bar forming the part of the T which projects into the mouth by wedging. The effect of this appliance will be to draw the central incisors inward and at the same time to force the side teeth outward. To prevent the incisors from returning to their abnormal position delicate rubber rings may be used, being slipped over the incisors and attached to a close-fitting retaining plate of rubber covering the roof of the mouth.

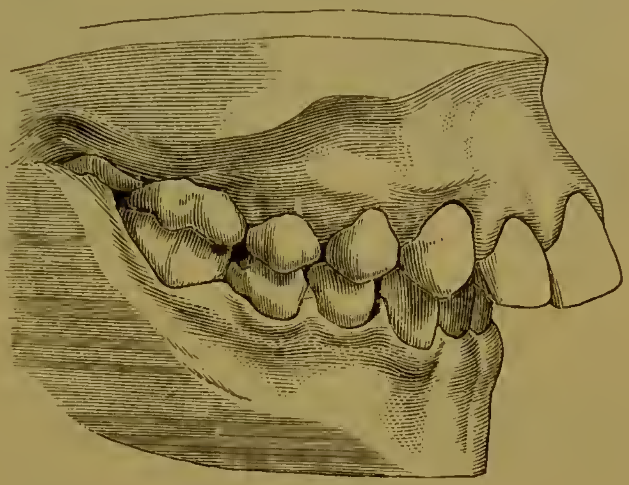


Fig. 229.

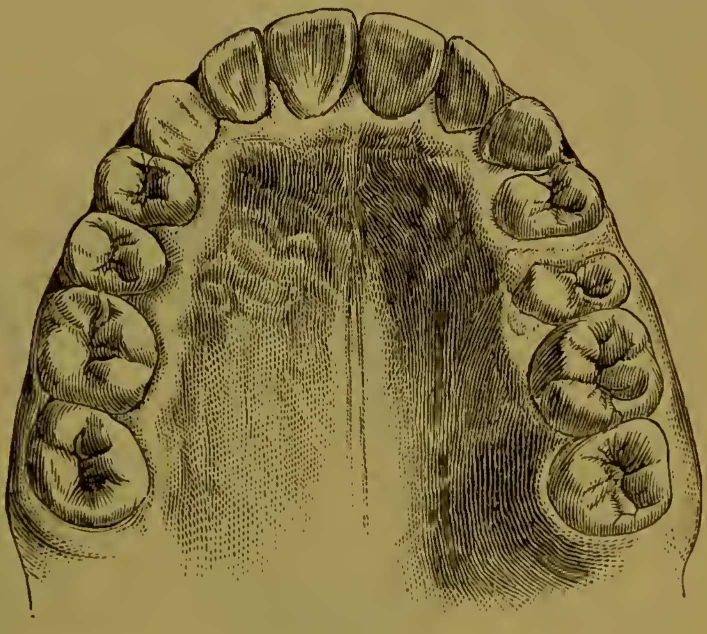


Fig. 230.

Figs. 229 and 230 will represent a case of irregularity before and after treatment, in the treatment of which the appliance above described is applicable.

Fig. 231 represents a similar appliance for correcting a form of irregularity consisting of the projection of the superior front teeth, where the force is applied to all of the projecting teeth at once.

Fig. 232 represents a vulcanite plate, with an alloyed gold and platinum band attached by means of screws suitable for moving back projecting front teeth after the necessary space is obtained by extraction of a bicuspid on each side. This appliance is very effectual and can be regulated by the patient using a common watch-key, or one made for the purpose, in order to increase the pressure of the band upon the projecting teeth. Small hooks attached to the front portion of the band and passing over the cutting edges of the incisors prevent the band from slipping up to the gum.

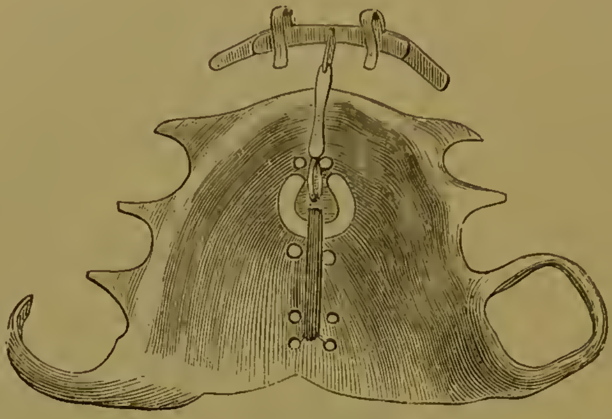


FIG. 231.

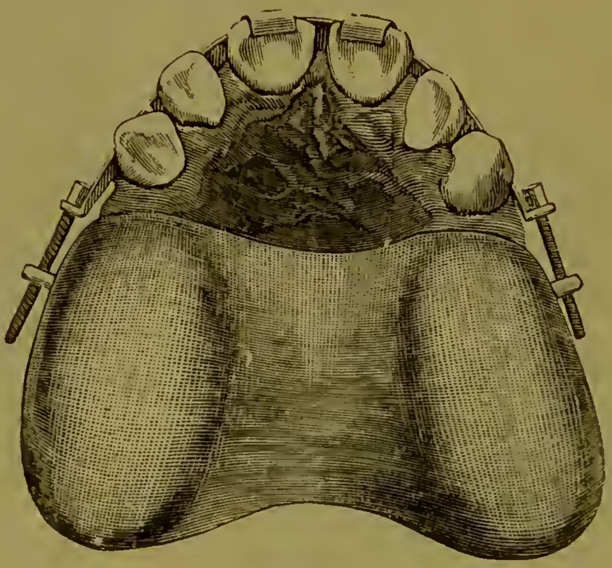


FIG. 232.

Fig. 233 represents a form of special loop for drawing back the canines, and which is attached to the same plate, the band being removed until after these teeth are moved.

A special plate may be constructed for the moving of the canines, or but one plate be employed, made of the form represented by Fig. 232, and which can be afterward modified, as in Fig. 234.

Dr. B. S. Byrnes has suggested a method of correcting certain forms of irregularities of the teeth by the motive-power of the "spring" or elastic force of thin gold bands, which he described at a meeting of the Southern Dental Association, as follows:—

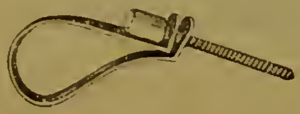


FIG. 233.

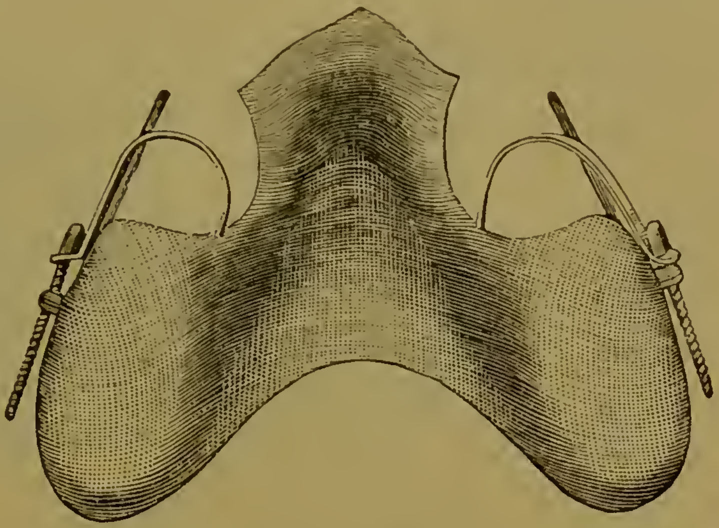


FIG. 234.

"My preference is gold of 20k. to 22k. fine, and, as a rule, the thinner the bands the better the result. It frequently occurs, of course, that for special cases or for a special purpose during the progress of any case the band must be doubled in thickness, but this fact does not change the rule as stated. The pressure exerted by the bands is gentle but constant, and the teeth upon which they operate are moved rapidly, with only the slightest inconvenience to the patient. No plates are used, the fixed points for the application of the motive power being supplied by such of the teeth as are suited to the purpose.

"The method of application is, in a general way, as follows: The fixed points having been determined, the tooth or teeth to be regulated are connected to them by means of a thin gold band. In selecting the fixed points care should be observed to choose teeth which will offer greater resistance to the force to be applied than those which are to be moved will. The band is then manipulated so as to form it into a spring or series of springs, so adjusted as to bear most powerfully on the misplaced tooth. Thus, suppose a projecting superior central incisor is to be drawn inward to align properly with the remainder of the teeth in the arch. A continuous gold band embracing the first molars on both sides is fitted around the outside of the arch. With a dull-pointed instrument like a burnisher the ribbon is then pressed into the interstices of the teeth over which it passes, thus forming it into a series of small springs. The incisor, being the most prominent point, will naturally be most affected by the pressure exerted by the springs, and in a short time it will be found to have moved away from the band so that it is no longer affected by the tension of the springs. As soon as this occurs the apparatus is removed, the ribbon is annealed, straightened, and a small portion, say a thirty-second to a sixteenth of an inch, as may be required, is cut out of it. The ends are then soldered and the appliance is replaced upon the teeth, the connecting band being formed into a spring as before. Tension is thus kept up until the tooth has assumed the desired position.

"This is the plan of procedure in ordinary, simple cases of irregularity, but the method is equally applicable to more complex conditions. I have not yet seen a case since my adoption of this device where it could not be made to do the work of moving the teeth readily. Sometimes the spring of the band may be advantageously supplemented by other aids, as the insertion of a rubber wedge at points where a particular gain is desired, in accordance with the recognized principle that in regulating teeth the movement is greatest where the elasticity is greatest.

"One of the most important points to observe in the treatment of a case of irregularity is to always have the fixture so tight that it is not necessary to tie it on to the teeth. I frequently apply fixtures by degrees; that is, after making a snug fit, force the appliance partially to place, then allow an interval, sometimes of half an hour, before proceeding to complete the adjustment. I find this plan lessens the severity of the operation to the patient, not only because of the rest afforded, but because the teeth seem more inclined to yield, and thus allow the fixture to be placed more readily.

"To apply the rubber wedge, select a strip of rubber of the desired thickness. Place the gold fixture, which should fit perfectly tight, in position, and insert the rubber behind the band opposite to one of the interstices. Take the ends of the rubber in either hand, stretch it to its fullest extent, and gradually work it to the desired spot; then clip off the ends. Press the teeth forcibly in the direction in which you wish to move them with one hand, while with the burnisher in the other the band is pressed into the interstices.

"Case I.—The first case which I shall describe is that of a young lady who at the time she came to me was in her eighteenth year. The condition of her teeth at that time is well shown in Fig. 235. The missing right superior central had been extracted when the patient was about eleven years old, as the only relief from the unendurable pain following devitalization of the pulp at the hands of an itinerant dentist. To supply the deficiency a partial plate of vulcanite had been worn for the last three and a half years. The remaining anterior teeth of the upper jaw had been gradually forced outward until at the time I first saw them they protruded at an angle of forty-five degrees. In the lower denture the incisors stood within the arch, the cuspids inclining forward. As a result of this conformation the chin was somewhat wrinkled and slightly upturned. The lips wore a constant pout, the mouth being what may be termed 'peaked.' The molars being the only teeth which occluded properly, the mouth was never naturally closed and the patient was unable to make an incisive bite.

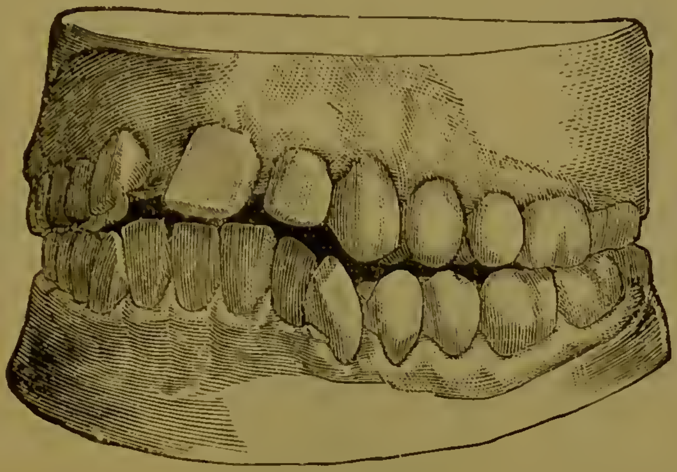


FIG. 235.

"In treating this case I aimed to compass four principal points: 1st, the destruction of the 'peakedness' by producing a broader or more oval arch; 2d, the reduction of the projecting teeth to their proper position; 3d, the improvement of the articulation; and, 4th, the closure of the space caused by the loss of the right superior central.

"The last mentioned was first undertaken. For the first two days a heavy band was used to force the ends or cutting-edges of the right lateral and left central together. A very thin, narrow gold band was then fitted to embrace the necks of these two teeth, and a wedge of wood was inserted under it on the side toward the cutting-edges, causing the teeth to move vertically toward each other. The band being placed around the necks, and the wood spreading it toward the cutting-edges, caused very great pressure at the apex of the root. Another band (Fig. 237) was then constructed to move the incisors backward and bring them into a more vertical position. This was placed in position without removing the first (Fig. 236). It consisted of two bands embracing the cuspids and bicuspids of each side, connected by another band of the same material passing outside of the incisors. The connecting band was then pressed into the interstices between the teeth and rubber wedges were inserted. This fixture caused constant pressure backward on the anterior teeth and an outward pressure on the cuspids and bicuspids. The gold band acted as a lever, the lateral teeth as the fulcrum, and the posterior teeth as the weight to be moved. The connecting band was cut and shortened

FIG. 236.

every other day, the patient having a sitting every day to allow the gold to be sprung more as the teeth moved away from it.

"At the end of three weeks the narrow band at the necks of the incisors was discarded, its work having been accomplished, and that shown in Fig. 237 was substituted by another, which passed around the outside of the whole arch from the first molar on one side to the corresponding tooth on the other. This appliance (Fig. 238) was required to do little actual work, its principal office being to hold the gain already made and to close the spaces between the teeth, which were now about equal in extent, and to bring the teeth to a vertical position. The gold was doubled in thickness over the incisors and cuspids, to prevent its yielding while the backward movement was progressing, which would allow the arch to again assume the peaked appearance which the treatment was undertaken to correct. The small hook or catch was to prevent the band from slipping up toward the gum, which it showed a tendency to do when first applied. The patient now wears a similarly shaped band, but only one-third as wide, as a retaining piece, which she removes and reapplies at pleasure.

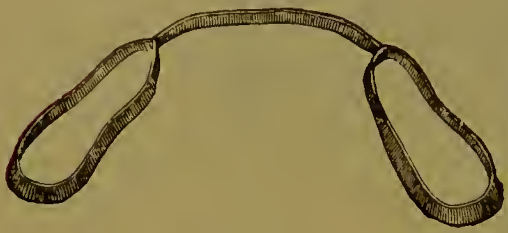


FIG. 237.

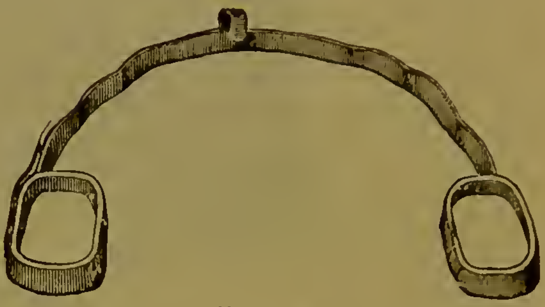


FIG. 238.

"The treatment of the irregularity in the lower anterior teeth was begun about a week after work on the upper jaw was commenced, and was completed in three weeks. A band, constructed as shown in Fig. 239, was applied, clasping the first molars on both sides and passing around the cuspids and behind the incisors. A wooden wedge was placed between the incisors and the band and springs formed by pressing the band into the interstices between the cuspids and bicuspids, cutting and readjusting as before. In

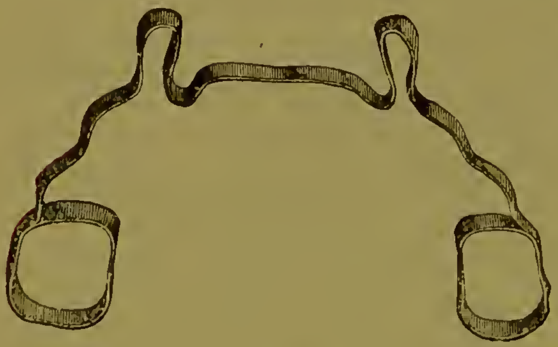


FIG. 239.

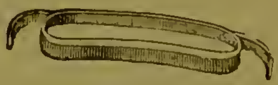


FIG. 240.

two weeks this fixture was substituted by another (Fig. 240). This was a plain band clasping the incisors, with wings tipping upon the cuspids, and having the portion behind the incisors doubled in thickness. A little block of rubber inserted under each of the wings completed the work in a week's time. The wings were then pressed back to hold the gain, and a piece given to the patient to wear as a retaining plate.

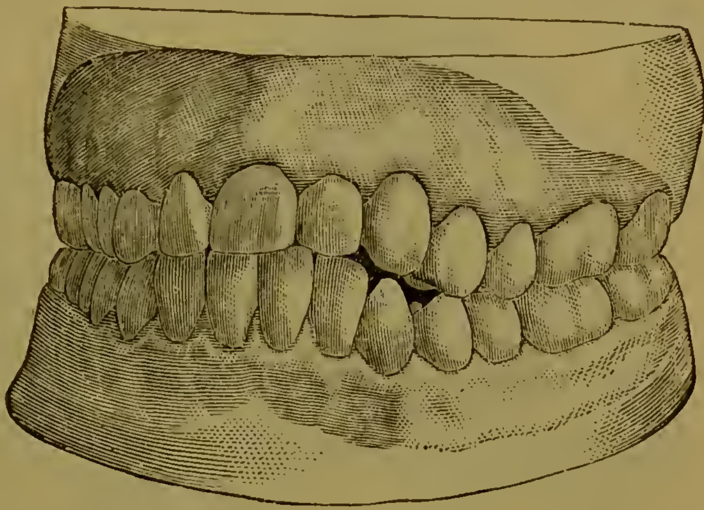


FIG. 241.

"Fig. 241 is an accurate representation of a cast of the mouth taken at the conclusion of the operation. The correction of the irregularities in this case was accomplished in a month, work being carried forward simultaneously in both jaws after the treatment of the lower teeth was commenced. The work of moving the upper teeth was pushed so rapidly as to slightly 'spring' the maxillary at the attachment of the compressor nasi and the depressor alæ nasi, so that the wings of the nose were pulled laterally inward and downward, causing a slight bulging or bridge on the centre of the nose. But I saw the patient some six months after the case was dismissed, and the muscles had adjusted themselves and no deformity was visible. The patient then informed me that she never had any trouble with either of the retaining fixtures."

Figs. 242 and 243 represent an ingenious appliance of Dr. Farrar for laterally moving the apices of the roots as well as the crowns of teeth. It consists of gold clamp-bands operated with a screw; fulcrums are placed between the teeth, to prevent the crowns from moving faster than the entire roots, these fulcrums being replaced by smaller ones as the teeth, under the pressure of the clamp-band, approach each other.

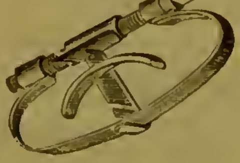


FIG. 242.

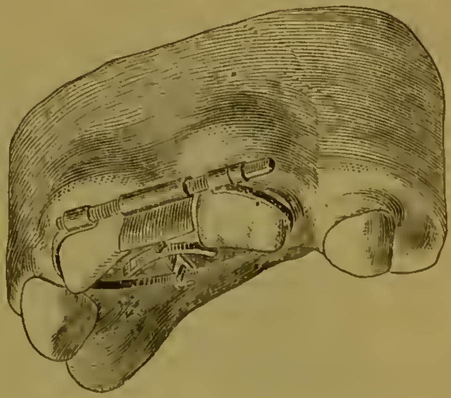


FIG. 243.

Retaining plates are generally required after the operation of moving teeth from irregular to regular positions is completed, for the greatest difficulty in correcting irregularity of the teeth is often caused by the tendency of such teeth to return to their old positions. It is necessary, therefore, that retaining plates should be worn until the corrected teeth become firmly fixed; and no definite time, although the average time may be stated as that of one year, can be given for the completion of such a process. Before permanently removing a retaining plate its use may be dispensed with for a short time, an examination being made daily to determine if there is any tendency of the corrected teeth to return to their irregular positions.

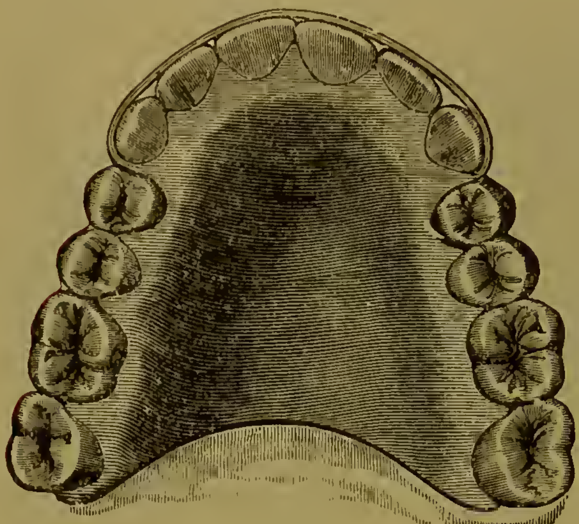


Fig. 244.

A simple form of retaining plate, to be worn after the correction of an irregularity caused by the projection of the superior front teeth, is represented by Fig. 244, which is a simple vulcanite plate with a small gold wire attached to it and passing to the outside of the front teeth through a small opening between the canine and bicuspid teeth on each side. After the correction of a contracted arch a simple vulcanite plate, such as is represented by Fig. 245, will answer as a retaining plate. A plate of this kind should be adapted to the palatal surfaces of all the superior teeth.

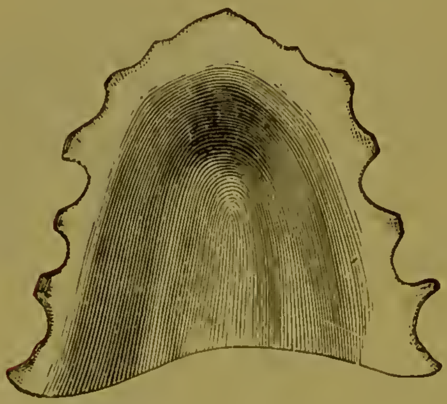


Fig. 245.

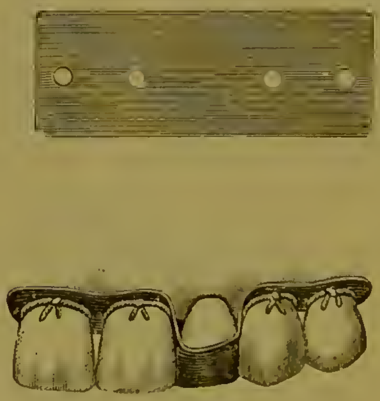


Fig. 246.

Fig. 246 represents an ingenious application of the rubber dam for the retention of replanted teeth and which may also be utilized for the retention of one or more irregular teeth after treatment, which is the suggestion of Dr. Herbst. The idea is so plainly shown by the illustrations that further description is unnecessary.

Wedges of elastic rubber are often useful in cases where the lower teeth shut outside the upper ones. They should be used of such a thickness as will exert a gentle pressure only upon the upper teeth.

Fig. 247 represents a case of this kind, with the wedges in position.

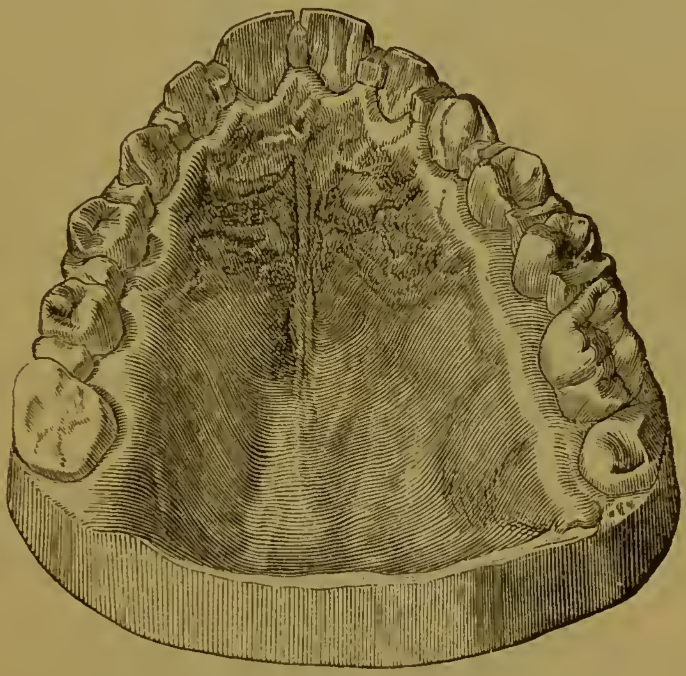


FIG. 247.

The jack-screw is also a valuable appliance for regulating teeth. Its use was first suggested by Dr. William H. Dwinelle, and it has been applied alone or in connection with a split-vulcanite plate. Figs. 248 and 249 represent different styles of jack-screws, the old and new, which are operated by holes in the middle bar; other holes render them capable of being secured to a tooth, thus avoiding the danger of being swallowed if accidentally detached. In some cases one end of

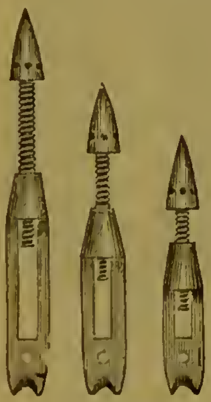


FIG. 248.

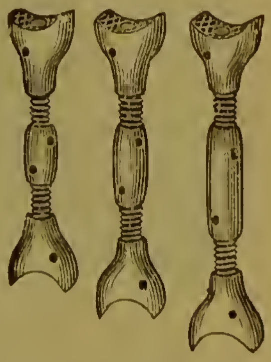


FIG. 249.

the first style of screw has been permanently imbedded in the rubber plate.

Dr. M. H. Cryer has designed an appliance by the use of which no injury results to the teeth while the jack-screws are in operation. It consists of thin platinum bands or clasps fitted to the teeth, the ends either soldered or held together by a small screw. The clasp which encircles the tooth to be forced outward contains a small hole for the reception of the point of the jack-screw, and upon the other clasp, which may encircle several teeth used as a fulcrum, small lugs are soldered, between which the other end of the jack-screw, which is of the form of a crotch, fits tightly, and is thus prevented from slipping.

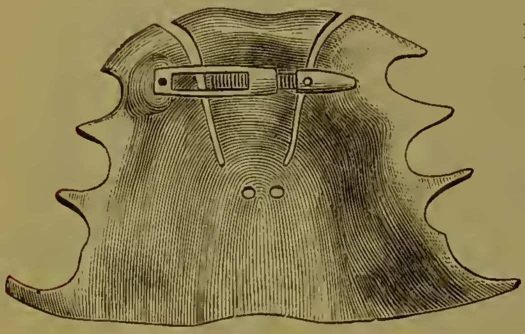


Fig. 250.

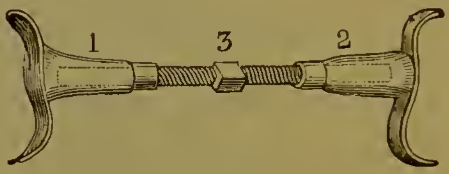


Fig. 251.

Fig. 250 represents a vulcanite split-plate with a jack-screw in position.

Fig. 251 represents a screw which is a combination of the two forms already alluded to, having upon its end a revolving crutch. Levers are also used with advantage on the outside of the arch, to press with a gentle force a deviating tooth, and thus move it into a proper position.

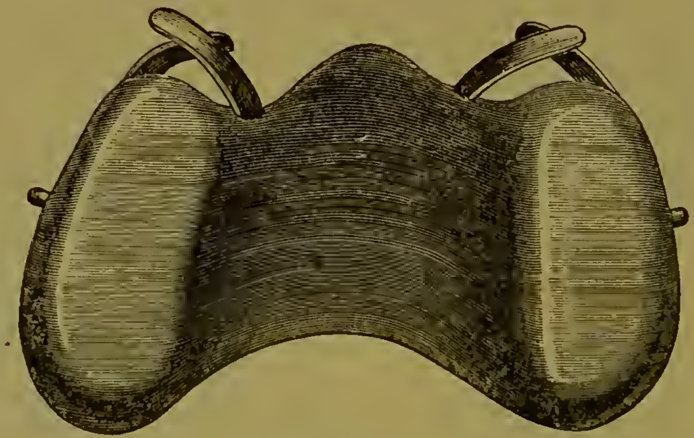


Fig. 252.

Fig. 252 represents a plate of vulcanized rubber with levers or springs attached.

Shortening the teeth has already been referred to in several of the cases presented, and it remains only to allude to an apparatus designed by Dr. Kingsley for such an object. It consists of a frame of gold adapted to the cutting edges of the incisors and lapping on

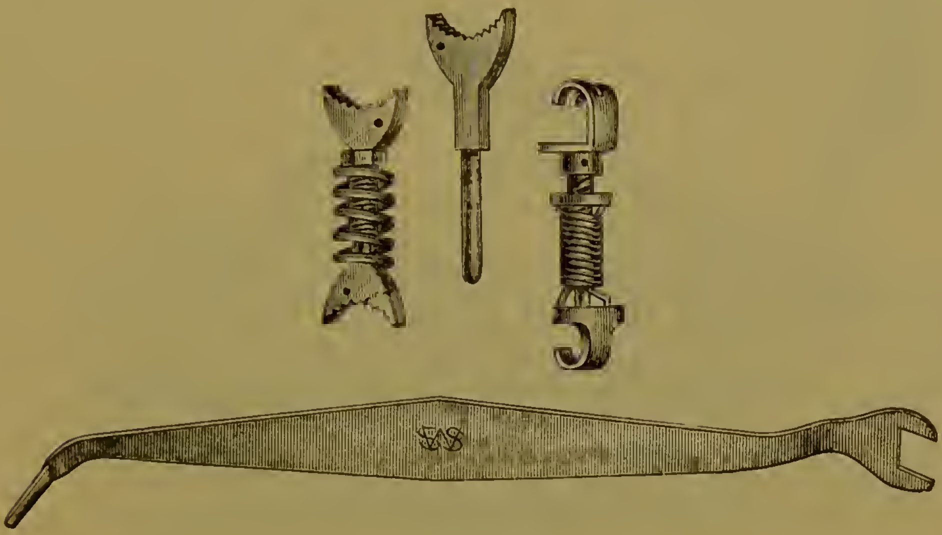
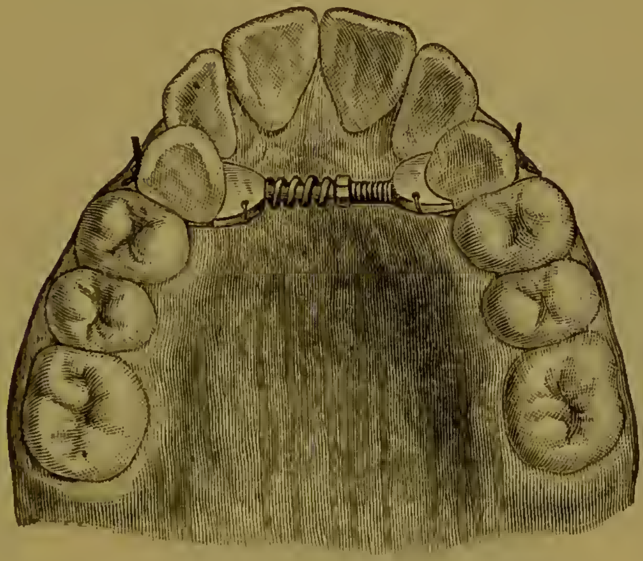


FIG. 253.



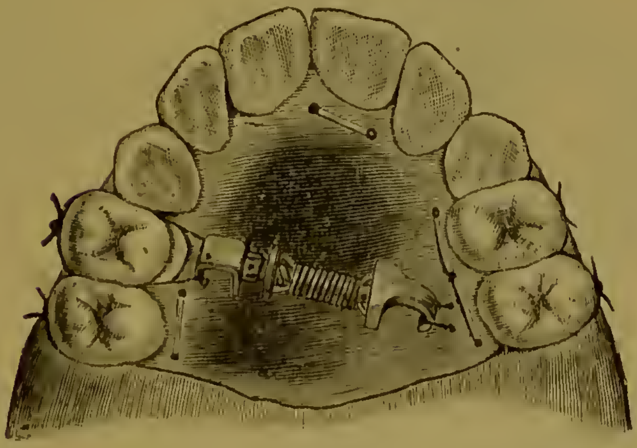


FIG. 254.

Figs. 253 and 254 represent the spring jack-screws of Dr. T. S. Holmes, which combine the pushing and pulling actions.

to the canines, to which is added a stud or post about half an inch in length, soldered to it opposite the canines, and coming out of each corner of the mouth. This apparatus is shown by Fig. 255. The arms extend upward, passing outside the cheeks, and consist of metal connected by elastic ligatures to a skull-cap. Fig. 256 represents the entire apparatus in action.

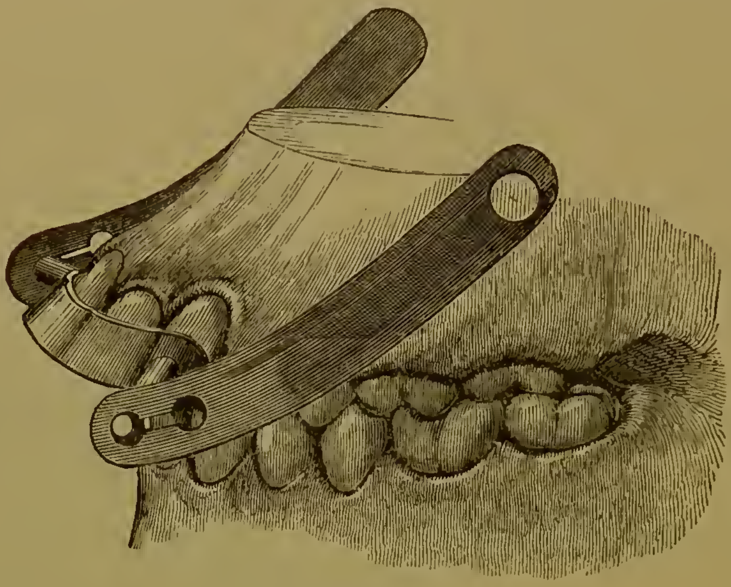


FIG. 255.

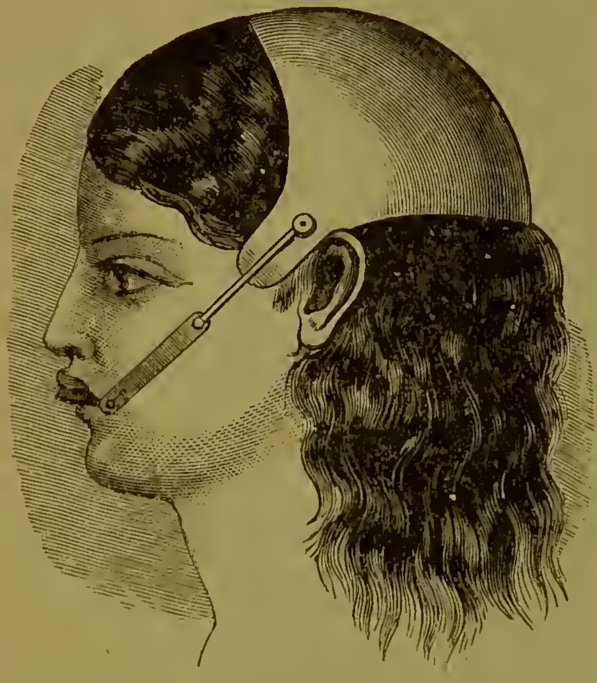


FIG. 256.

For lengthening a short tooth Dr. J. D. White suggests the simple method of tying a thread ligature tightly around the neck of the tooth, under the free margin of the gum, and if much irritation and pain result, to remove the ligature and, keeping the tooth at rest, apply a little pounded ice, in a bag, to the gum. After a week's rest the same treatment is to be pursued every alternate week, until the end is accomplished. But great care is necessary to keep the irritation within proper bounds, this treatment being applicable only to growing teeth, although occasionally to matured teeth also.

The following is an appliance designed by Dr. Farrar to bring into its proper place in the arch an impacted canine, represented by Fig. 257, which will also prove effectual for elongating a tooth. It consists of a narrow gold plate (see Fig. 258), swaged to fit the palatal margins of the gum and surfaces of the lateral incisors and bicuspids, with thin crossbars, or a clasp around the first bicuspid, connecting this plate with a smaller one adapted to the labial margin of the gum. To the small plate or pad, as it is termed, a smooth nut is soldered, through which passes a screw, its lower end bent so as to enter a small hole drilled into the crown of the short tooth, which, by means of a thread-nut, is forced downward.

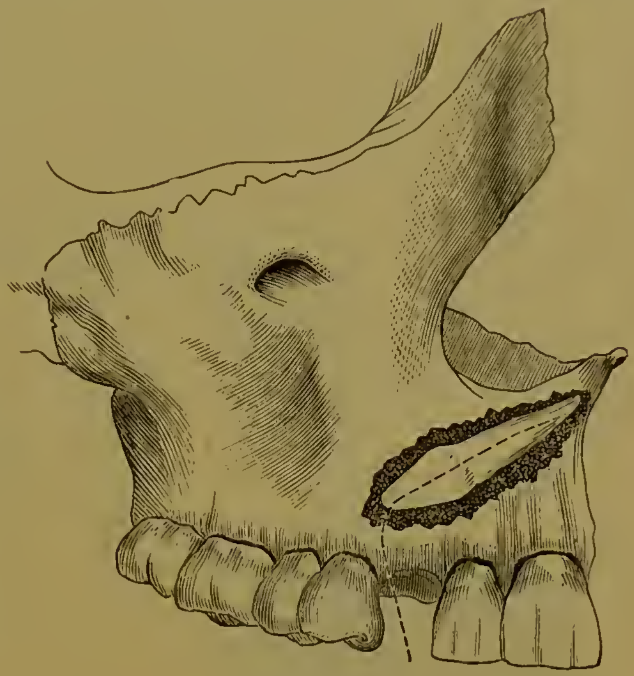


FIG. 257.

The elongated tooth is retained in its new position by the delicate apparatus represented by Figs. 259 and 260.

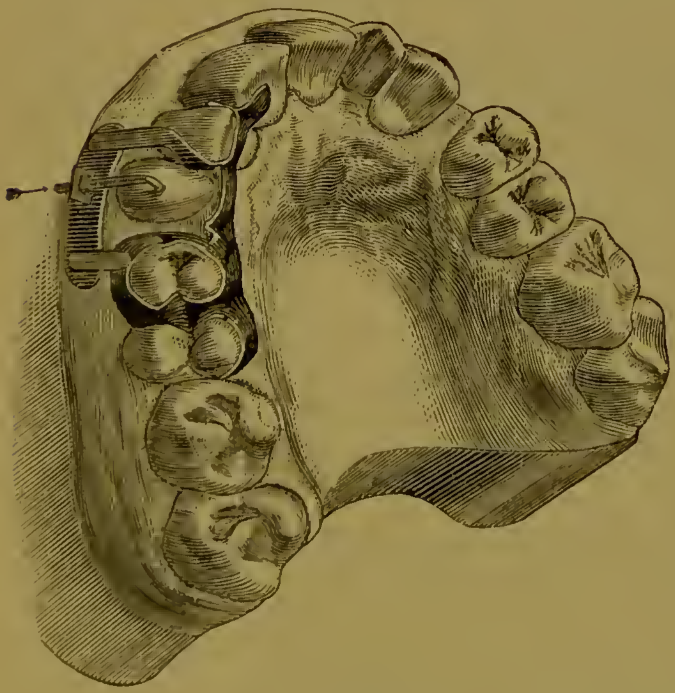


FIG. 258.

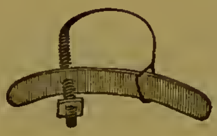


FIG. 259.

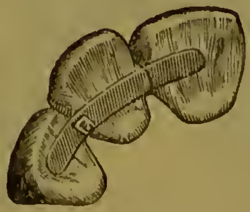


FIG. 260.

The action of an elastic spring, the free end of which acts upon the short tooth while the other is imbedded firmly in a rubber plate, will often answer the purpose of elongating a tooth.

Dr. A. E. Matteson has suggested an appliance to force the eruption of teeth which are impacted in the jaw in such a manner as to prevent their occluding or meeting with the opposite ones when the jaws are closed. It is described as follows: A rubber plate is made to cover the roof of the mouth and to fit the necks of the teeth closely. A French clock spring is adjusted to the rubber plate in such a manner that one end is riveted into the central posterior part, so that when the spring is forced up against the plate its distal end touches the necks of the teeth to be drawn out. Ligatures are then fastened to the necks of the teeth and the spring carried up to the plate and secured to the teeth (Fig. 261). With a sufficiently powerful spring from two to four teeth may be operated upon at one time.

Fig. 262 shows a similar appliance for operating upon impacted lower teeth.

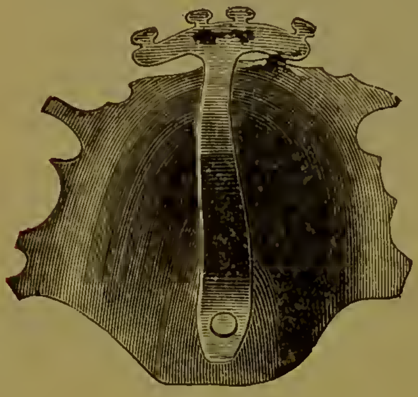


FIG. 261.

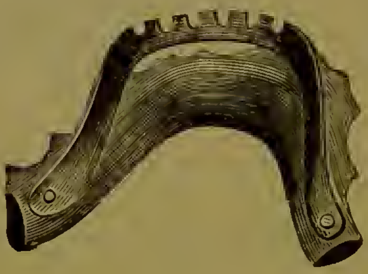


FIG. 262.

For the same purpose, Dr. E. S. Talbot suggests the following appliance: A rubber plate is made to fit the jaw and the teeth, into which a hole is drilled at a point in the center of the space made by the missing or impacted tooth, smaller than the one arm of the coil-wire spring it is to hold. The other arm of the spring, upon the end of which is a loop (Fig. 263), meets the neck of the tooth to be moved, and is there secured with a ligature. When the tooth is so imbedded in the process that a ligature cannot be fastened to it, a platinum band with a hook soldered upon it may be forced up under the gum and secured with oxyphosphate of zinc. If this fails, a hole may be drilled into the crown of the tooth and an eye-bolt fastened in with cement, to which the spring can be secured by means of a ligature. By drilling the hole in the rubber plate at a longer distance from the impacted tooth, a greater spring is given to the wire.

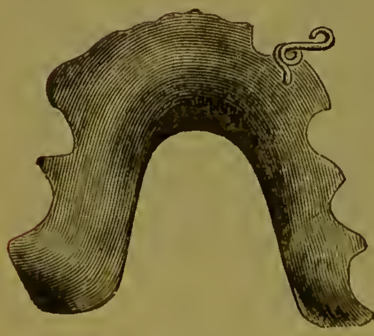


FIG. 263.

Deformity from Excessive Development of the Teeth and Alveolar

Ridge of Lower Jaw.—When the teeth of the lower jaw form a larger arch than those of the upper, the incisors and cuspids of the former shut in front of those of the latter, causing the chin to project, and otherwise impairing the symmetry of the face. Figs. 264 and 265 present a front and a side view of this deformity. It may result from a want of correspondence in the development of the teeth and alveoli of the two maxilla, the upper jaw being defective in size, while the lower jaw is natural; or the former being natural, the latter may be in excess. It may also arise from a simple eversion of the lower teeth or inversion of the upper.

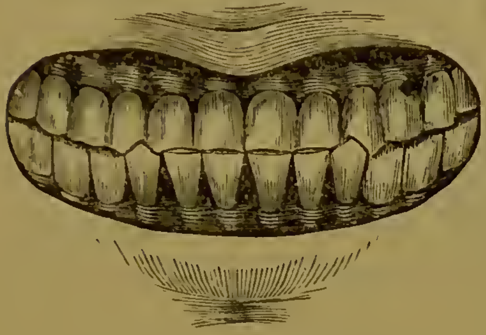


Fig. 264.

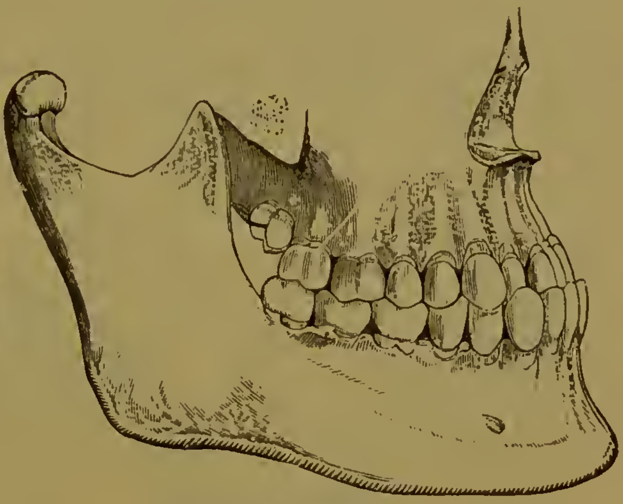


Fig. 265.

Treatment.—The remedial indications of the deformity in question consist in diminishing the size of the dental arch, which is always a tedious and difficult operation, requiring great patience and perseverance on the part of the patient and much mechanical ingenuity and skill on the part of the dentist. The appliances to be employed have of necessity to be more or less complicated, requiring the most perfect accuracy of adaptation and neatness of execution; they must also be worn for a long time, and, as a natural consequence, are a source of considerable annoyance. The first thing to be done is to extract the first inferior bicuspids. Sufficient room will thus be obtained for the contraction which it will be necessary to effect in the dental arch for the accomplishment of the object. An accurate impression of the teeth and alveolar ridge should be taken with wax softened in warm water, and from this impression a plaster model is procured, and afterward a metallic die and counter-die, in the manner to be described in a subsequent chapter.

This done, a gold plate of the ordinary thickness should be swaged to fit the first and second molars (if the second has made its appearance, and if not, the second bicuspid and first molar on each side), so as completely to encase these teeth. If these caps are not thick enough to prevent the front teeth from coming together, a piece of gold plate may be soldered on that part of each which covers the grinding surfaces of the teeth. Having proceeded thus far, a small gold knob is soldered to the inner and outer front corner of both caps, and to each of these a ligature of silk or rubber is attached. These ligatures are to be brought forward and tied tightly around the cuspids. When thus adjusted the lower arch will present the appearance exhibited in Fig. 266. By this means the cuspids may, in fifteen or twenty days, be taken back to the bicuspids. If in their progress they are not carried toward the inner part of the alveolar ridge, the outer ligatures may be left off after a few days, and the inner ones alone employed to complete the remainder of the operation.

After the positions of the cuspids have been thus changed, a circular bar of gold should be made, extending from one cap to the other, so as to pass about a quarter of an inch behind the incisors, and be soldered to the inner side of each cap. A hole is to be made through this band, behind each of the incisors, through which a ligature of silk may be passed and brought forward and tied tightly in front of each tooth. These ligatures should be renewed every day until the teeth are carried far enough back to strike on the inside of the corresponding teeth in the upper jaw.

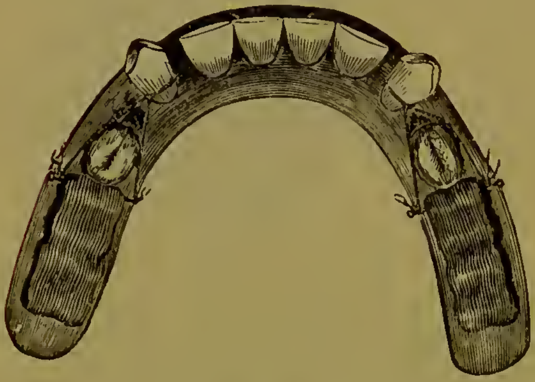


FIG. 266.

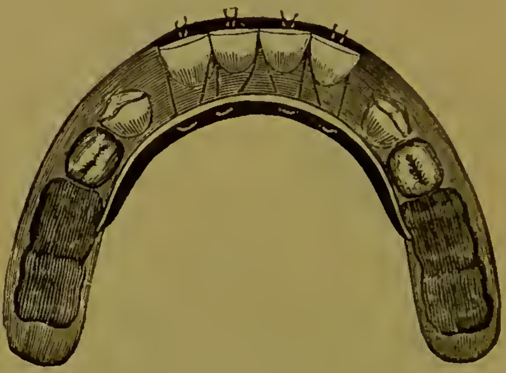


FIG. 267.

Fig. 267 represents the appearance which the lower jaw presents with the last-named apparatus upon it, and will better convey an idea of its construction, the manner of its application, and its mode of action, than any description which can be given.

An appliance of this sort may be made to act with great efficiency in remedying the deformity in question; but in its application it is necessary that the caps be fitted with the greatest accuracy to the teeth, and they should be removed every day and thoroughly cleansed, as well as the teeth they cover. If this precaution is neglected, the secretions of the mouth, which collect between the gold caps and teeth, will soon become acid and corrode the latter.

The remarks made in the previous chapter upon the use of the vulcanite are applicable here. Such a plate, for this class of cases, is readily made, and inflicts no injury upon teeth or gums. Elastic instead of silk ligatures might be used, and the retraction of the incisors carried on simultaneously with that of the cuspids. The use of vulcanized rubber instead of gold is of great value in correcting irregularities of this nature, the form of the appliances being the same.

The employment of elastic rubber ligatures in connection with vulcanite plates is generally found to be effectual in correcting the irregularity of the inferior front teeth. The following appliances, from designs of Dr. Kingsley, will be found serviceable:—

Fig. 268 represents an appliance for correcting an irregularity where the inferior canine teeth stand outside the arch, which is somewhat narrow, the first permanent molars being first extracted. Hooks of gold wire are inserted in the plate as points of attachment for the elastic bands, which are drawn forward and attached to the canines by silk or linen threads. By such means the canines were drawn into position and the arch widened.

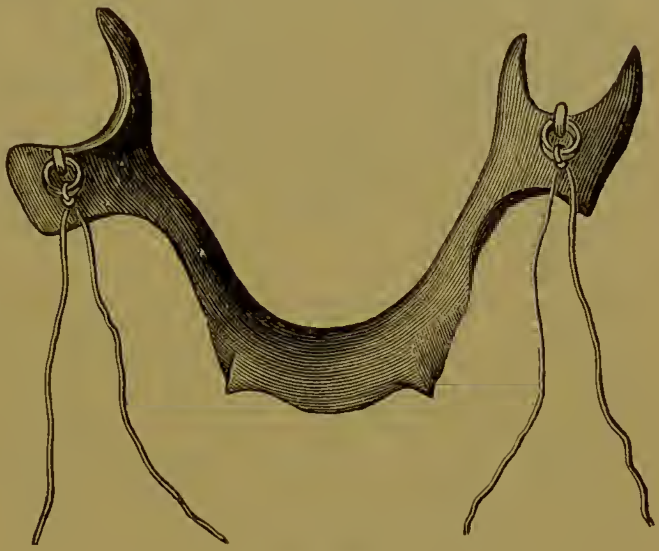


Fig. 268.

Fig. 269 represents other forms of attachment for elastic bands and ligatures.

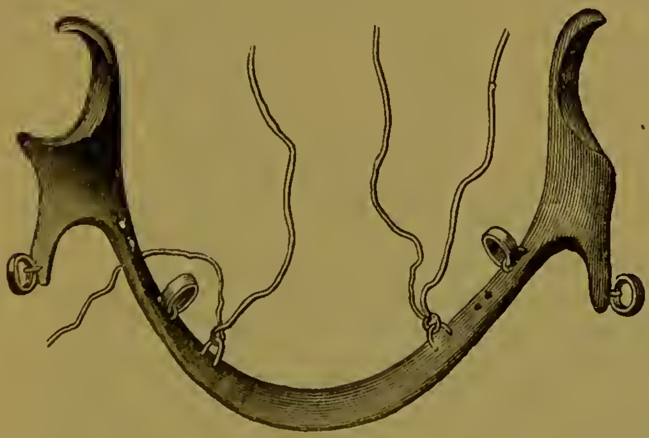


Fig. 269.

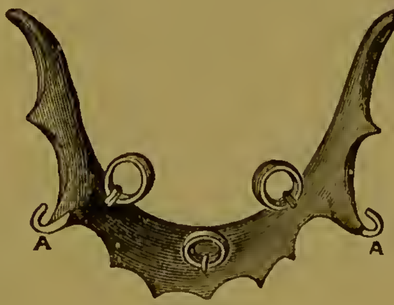


Fig. 270.

Fig. 270 shows an appliance for correcting the irregular arrangement of the four inferior incisors. Gold wire hooks (A A) pass over the arch between the canines and adjoining teeth, in order to give an independent attachment for the elastic ligatures outside as well as within the arch, and movements in almost any direction can be obtained.

For cleansing purposes such appliances can be removed and replaced by the patient.

Protrusion of the Lower Jaw.—This deformity, although produced by a different cause from the one last described, is similar to it, and gives to the lower part of the face an unnatural and sometimes disagreeable appearance. It also interferes with mastication, and often with prehension and distinct utterance. It wholly changes the relationship which the teeth should sustain to each other when the mouth is closed. The cusps or protuberances of the bicuspids and molars of one jaw, instead of fitting into the depressions of the corresponding teeth of the other, often strike their most prominent points; at other times the outer protuberances of the lower molars and bicuspids, instead of fitting into the depressions of the same class of teeth in the upper jaw, shut on the outside of these teeth. The trituration of aliments is consequently rendered more or less imperfect.

This protrusion of the lower jaw is supposed by some to be the result of a "natural partial luxation." In fact, its causes are by no means clearly understood. It is often hereditary, and would seem to be caused by that mysterious agency which impresses peculiarities of growth and shape, not only upon the lower maxilla, but upon every bone in the body. The agency is so constant and overruling that we must be prepared to find the jaw returning to its position after the discontinuance of treatment, unless, by the interlocking of the cusps of the upper teeth and the overlapping of the upper incisors, we can restrain the tendency. It is of more frequent occurrence than the one which results from excessive development of the teeth and alveolar ridge, and requires, as before stated, an entirely different plan of treatment. It rarely occurs previously to second dentition.

Treatment.—The plan of treatment formerly adopted consisted in fastening on each side a cap of vulcanite on one of the lower molars, thick enough to keep the front teeth about a quarter of an inch apart when the jaws were closed. Fox's bandage was then applied. This was buckled as tightly as the patient could bear with convenience, pressing the chin upward and backward. A piece of tough wood, slightly hollowed so as to fit the arch of the lower teeth, made narrow at the upper end, was introduced between the teeth several times a day, the concave portion resting upon the outside of the lower and against the inside of the upper, employing at each time as much pressure as could be safely applied. By continuing this operation from day to day, for several weeks, the natural relationship of the jaws would, in most cases, be restored.

The description of bandage here alluded to, and the manner of its application, is represented in Fig. 271. When the protrusion of the lower jaw is accompanied by irregularity, means should at the same time be employed for remedying it. The earlier the treatment is instituted the more easily will the deformity be overcome. It may, however, be successfully remedied at any time previously to the twentieth year of age, and sometimes at a much later period, but after this time the operation becomes more difficult.

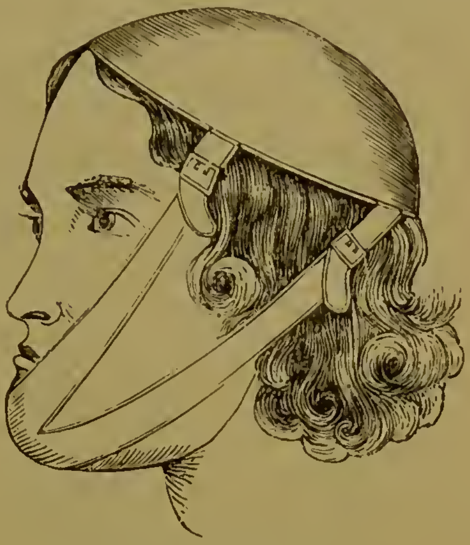


FIG. 271.

An appliance designed by Dr. G. S. Allan (Fig. 272), and which he employed successfully, consists of a brass plate to fit the chin, having arms with hooked ends reaching to a point just below the point of the chin. The arms are arranged in such a way that the distance between them can be altered at will by simply pressing them apart or together. The upper part consists of a simple network going over the head and having two hooks on each side, one hook being above and the other below the ear. The network and the chin-plate are connected by four elastic rubber ligatures exerting pressure in such a manner as to force the lower jaw almost directly backward. The upper elastics are used simply to keep the mouth closed so that the lower elastics will not pull it open, the upper being made just strong enough so that the muscles of the mouth need not be strained to keep the jaw open during the operations of eating and talking.

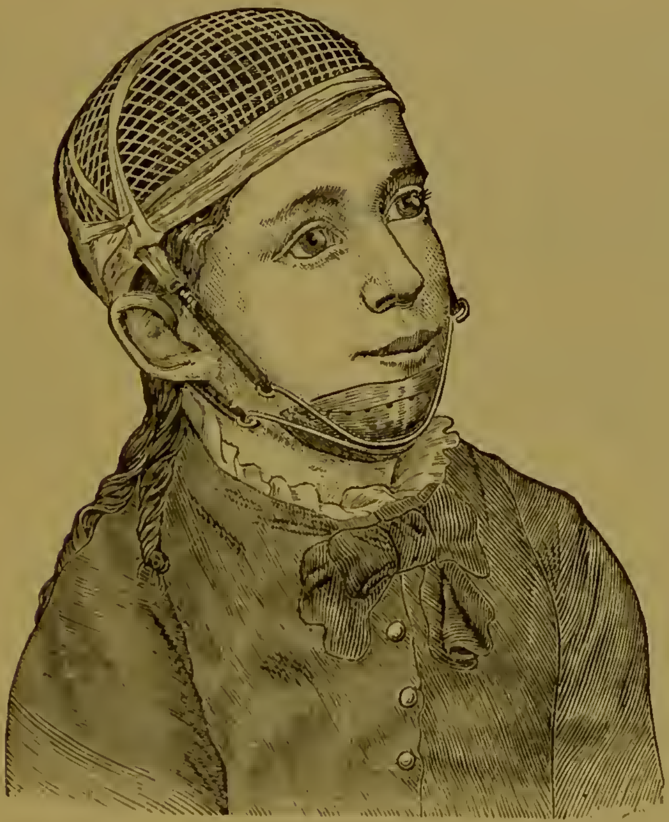


FIG. 272.

In cases where the lower front teeth close over the upper, and thus cause a deformity of the face, it is important to discriminate correctly between those which result from malformation and a protrusion of the jaw occasioned by partial luxation, as the remedial indications in the two are entirely different. Those which would prove successful in the one would prove unsuccessful in the other. But, fortunately, deformity arising from the last-mentioned cause is comparatively of rare occurrence; hence, the dentist is seldom called upon to exercise his ingenuity and skill in its treatment.

Dr. Edward H. Angle's system of correcting irregularities of the teeth is described by him as follows:—

"In studying the conditions by which we may best accomplish the movements of the teeth, we may simplify the process if we remember the movements in the line of the arch, which are five: forward, backward, inward, outward, and partial rotation. These and their slight modifications, with the exception of elongation and depression, which are rare, are all we are called on to perform. The principles governing all of these movements are the same. So that, by understanding the principles governing one, we may comprehend all.

"In applying force to a tooth, it should be sufficient to accomplish the movements as rapidly as is consistent with physiological law. When pressure is once applied it should be continued without relinquishment, for there should be no retrogression of the tooth.

"After the mal-posed tooth has been moved into the desired position and proper occlusion secured, it should be firmly supported and retained till it has become firm in its new socket.

"*Appliances.*—The Set No. 1, Fig. 273, consists of the retaining-wire G, and ten sections of retaining and anchor pipes R, R, which will closely slide on wire G. The traction screw A has its smooth end bent for insertion in the short tube D. When the nut is against the A end of the long tube, and that tube soldered to a tooth-band, turning forward the nut will *pull* the hook in the tube D when that has been soldered to a tooth-band; if the nut is against the other end of the long tube, it will *push* D and its tooth-band. B, C is a like but smaller combination, of the same diametric size as the jack-screw J. When the tube of J is soldered to a tooth-band on one tooth, it will *push* directly against a notched tooth-band or a tooth. E is a longer piece of the tube than is shown on J, with which a longer jack-screw may be made when required. The thinner coil of band-material is seen at F, the thicker at H, either of which is sufficient to make about twenty-five tooth-bands. The rotating levers L, three sizes of two each, and wrench W, complete the set, which will suffice for several regulating cases.

"It will thus be seen that the appliances of this set are very simple and few in number, being limited practically to three,—viz.: the lever for rotating, the screw for pushing, and the traction-screw for pulling; and the other pieces for the purpose of securing attachments. Aside from their advantages of simplicity, efficiency, and cleanliness, their intelligent application will effect a stationary anchorage upon, a positive movement of, and afterward a firm retention of, the teeth.

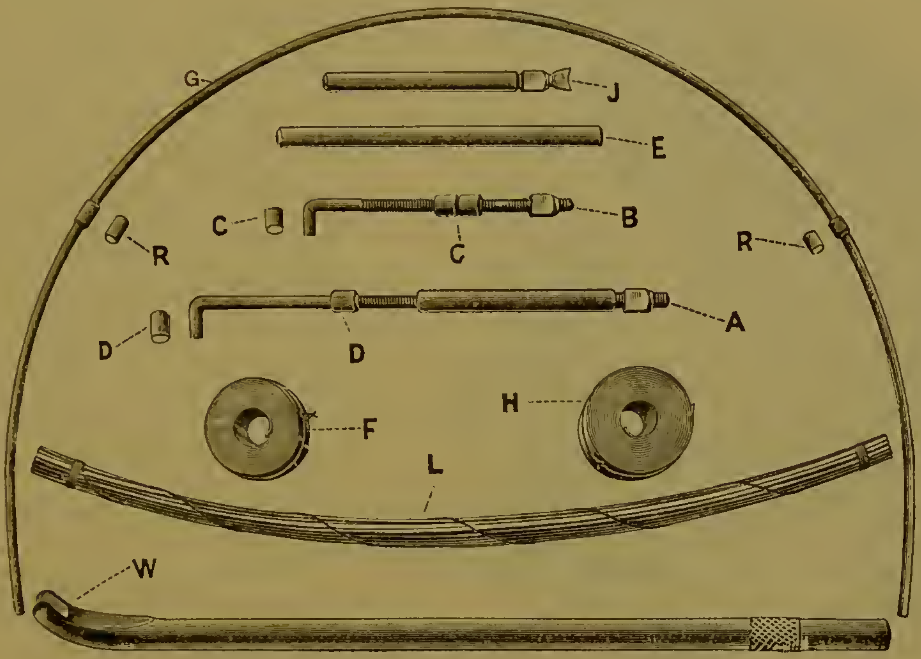


FIG. 273.—SET NO. 1, ANGLE'S APPLIANCES.

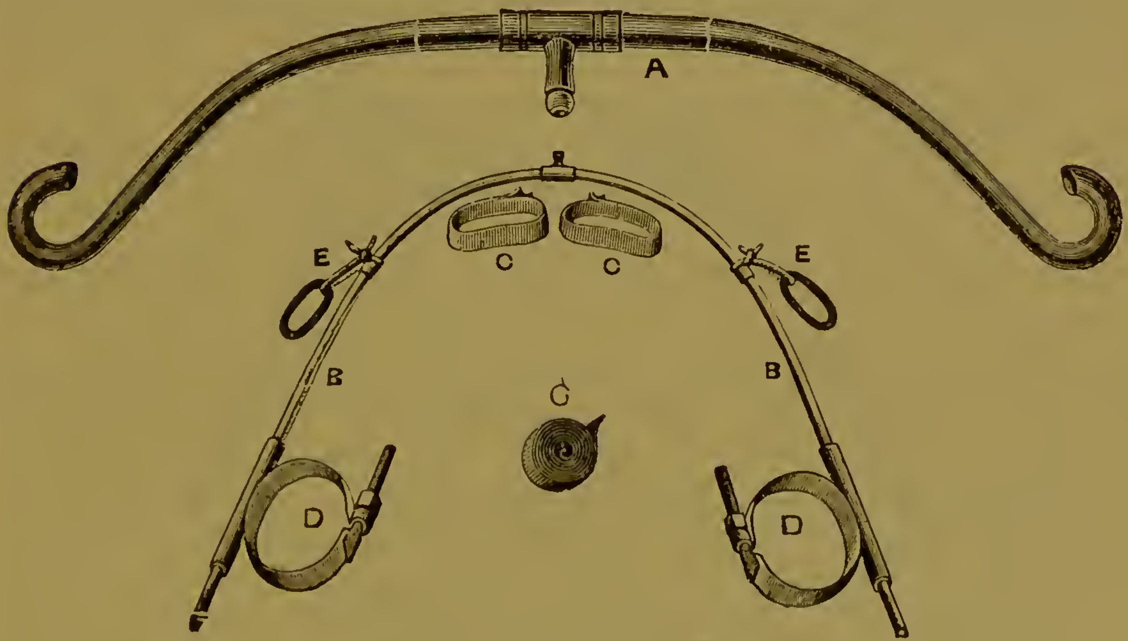


FIG. 274.—SET NO. 2, ANGLE'S APPLIANCES.

"Set No. 2 is designed for the treatment of a special class of irregularities, or that prognathic type known as excessive protrusion of the upper incisors. The plan of this set (No. 2) differs principally from that of Set No. 1 in that the anchorage is occipital, or by means of a cap covering the back of the head (as seen in Fig. 275), to which heavy elastic bands are attached and received by the hooks upon the ends of traction-bar A. The wire arch B encircles the dental arch and bears against the protruding teeth, receiving the necessary pressure from the standard in the center of the traction-bar. D, D represent adjustable anchor clamp-bands and pipes for securing the ends of the arch B upon the molar teeth, while C, C represent plain bands for holding in position upon the teeth the anterior part of the arch. C is a coil of band-material, from which the bands C, C are to be made for each case. This coil is the same as F, Fig. 273, Set No. 1. E, E represent small rubber rings to retain the teeth during intervals of rest, when not wearing the head-cap and traction-bar.

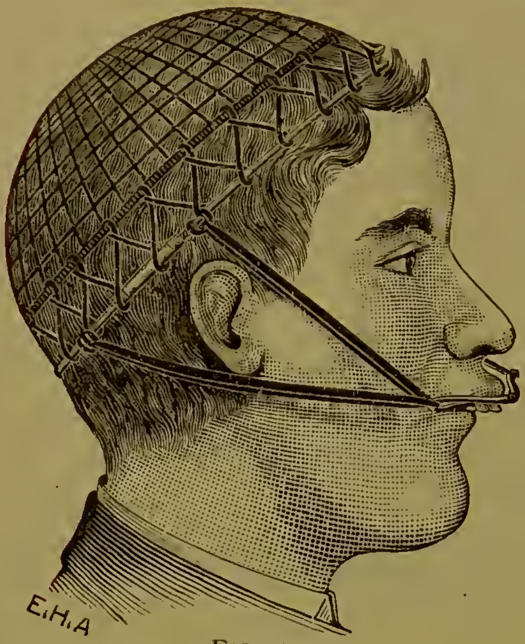


FIG. 275.

"Fig. 276 shows an extra wire expansion-arch. Its use is directly the opposite that of wire arch B, in that it is used for expanding the arch, and is to be known as the expansion-arch E. The ends of this arch are threaded and provided with nuts. By putting the threaded ends into the anchor-tubes upon the clamp-bands D, Set No. 2, secured to anchor-teeth, the arch may be pushed forward by tightening

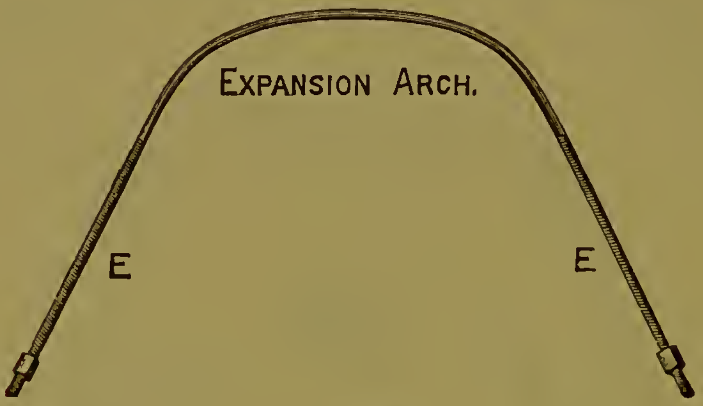


FIG. 276.

the nuts, thus exerting force against other teeth which may have been secured to the arch by means of ligatures or bands.

"In Fig. 277 is shown a metal cap covering the chin, and in connection with the head-gear and heavy elastic bands it is used in the retraction of the inferior maxilla, as shown in the figure. This cap is light, nicely made, highly polished, and will fit all cases, as it is necessary for the fit to be only approximately accurate. A layer of absorbent cotton should always be placed between the metal and the chin while it is being worn.

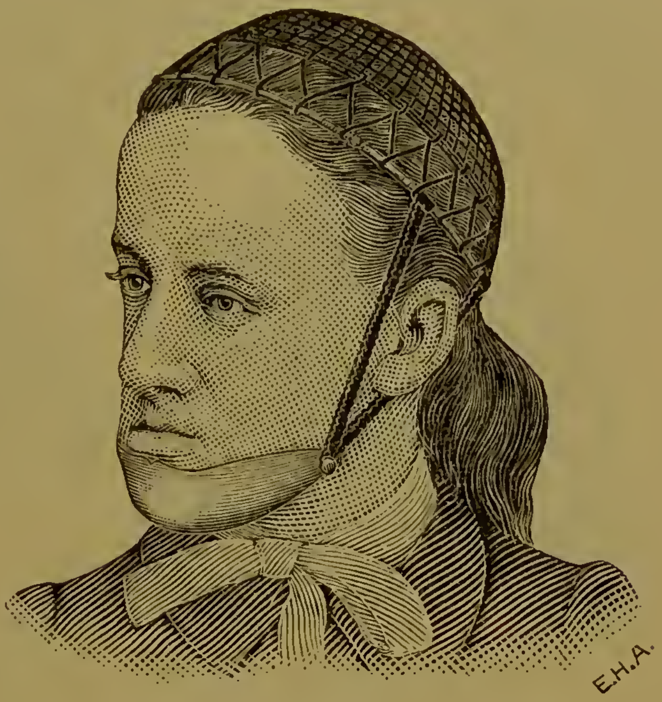


FIG. 277.

"Fig. 278 represents adjustable clamp-bands for encircling the molars and bicuspids, to which are attached the various appliances. Nos. 3 and 4 have pins soldered to their sides, to which ligatures may be attached. This style of band is especially designed for the treatment of fractures of the maxillæ, and its use, therefore, is fully shown in that portion of this work devoted to such treatment, but it is also useful in the regulation of teeth, as described later.

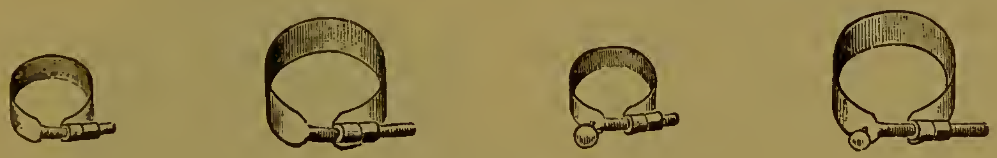


FIG. 278.

NO. 1—BICUSPID. NO. 2—MOLAR. NO. 3—BICUSPID. NO. 4—MOLAR.

"The head-cap represented as covering the back of the head (Fig. 277) is also an extra. It is beautifully made and presents a very neat appearance, is strong, durable, and may be quickly adjusted to fit any size of head. As auxiliaries to the above appliances, ligatures made from waxed floss silk, or wire, are necessary.

"*Direction of Forces for Tooth-Movement.*—In the correction of dental irregularities, an appliance must act either by pulling, pushing, or twisting a tooth into proper position; and the movements of the tooth are limited to six: backward or forward in the line of the arch, outward or inward in the line of the arch, elongation or depression of the tooth in its socket.

"The backward movement of the teeth in the line of the arch is accomplished in two principal ways. First, by the large traction-screw A and D, Set No. 1, shown in Fig. 279, for the retraction of a superior cuspid. The first molar is encircled by a No. 2 clamp-band (Fig. 278), to which is soldered the long sheath of the traction-screw A, Fig. 273. The cuspid is also encircled by a band, having the short tube D, Set No. 1, soldered horizontally to it on its distal surface, with which tube the smooth bent end of the traction-screw engages. The nut, operating against the distal end of the tube, will move the cuspid backward into position. The easiest way to adjust this appliance is to first cement the band upon the cuspid; after the cement has become thoroughly set, the angle of the traction-screw is hooked into the short tube, and the adjustable band latched over the molar. It is very important that the bent end be passed into the tube its *full length*, otherwise it will be broken when force is exerted. The screw may be employed on the outside of the arch; the short tube, in that event, should be attached to the mesio-buccal angle of the band, as shown on the right cuspid of Fig. 280.

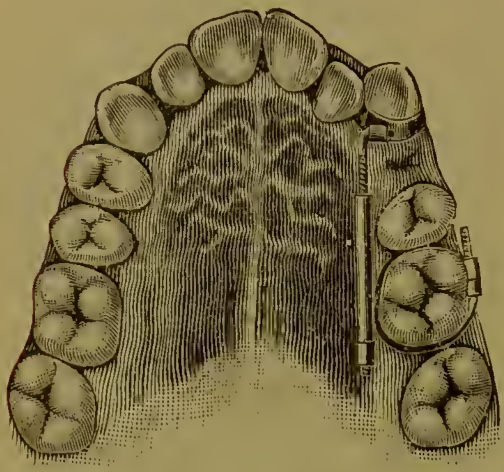


FIG. 279.—RETRACTION OF CUSPID.

"If a movement of rotation as well as retraction is desirable, the angle of the screw should be hooked over a spur, as shown on the left cuspid of Fig. 280, thus concentrating all the force upon one side of the moving tooth. Recent experience has shown that a staple made from the wire G, Set No. 1, is stronger and better than the spur for making this attachment. Should the cuspid be very prominent, requiring the movement to be inward as well as backward, that may be accomplished at the same

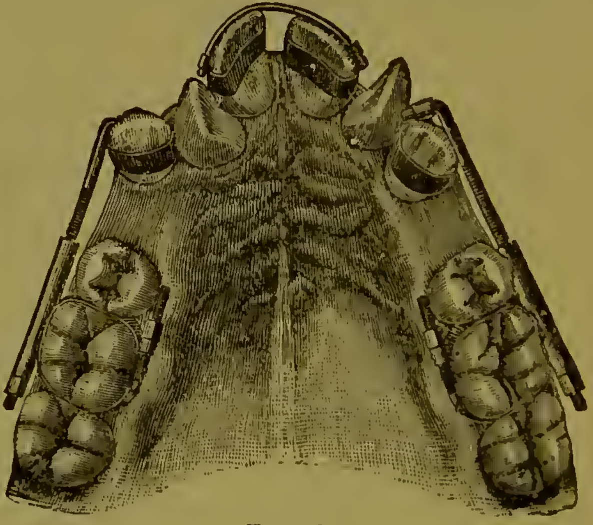


FIG. 280.

time by bending the screw, which, as the nut is turned, will be gradually straightened. (See Fig. 281.)

"A method of reinforcing the anchor-tooth is also shown in this engraving, by enlisting the resistance of the lateral incisor. This tooth is banded and provided with one of the pipes R, Set No. 1, soldered to its distal angle; one end of a piece of the wire G, Set No. 1, is soldered to the sheath of the traction-screw and made to rest in this pipe.

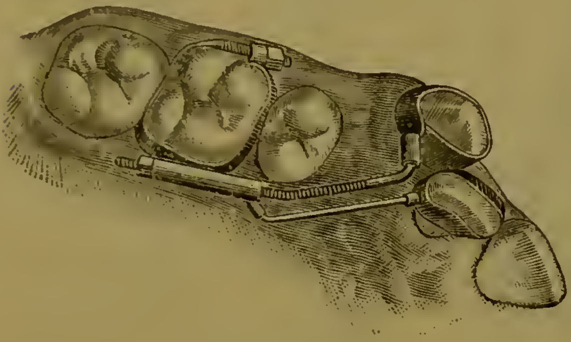


FIG. 281.

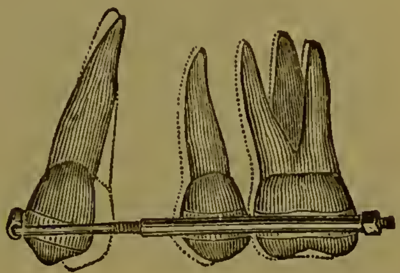


FIG. 282.—STATIONARY ANCHORAGE.

"In making the attachments for retraction after the manner described, it is of the utmost importance that the band encircling the molars should be tightly clamped, burnished, and firmly cemented, so that the attachment will be perfectly rigid. In this way the resistance of the anchorage will be greatly increased, and tipping of the anchor-teeth will be prevented; while if moved at all, they must be dragged bodily through the alveolus, because the apices of the roots move equally with the crown, as shown in Fig. 282, which represents a side view of the appliance in position, the dotted lines showing the movements which must take place if the attachment is properly made. This is a most perfect form of anchorage, and I am indebted to Dr. W. C. Barrett for first suggesting it.

"If the nut is placed upon the screw in front of the sheath and tightened, force with the same resistance of anchorage may be exerted in moving the tooth forward instead of backward. When the jack-screw is employed for pushing, the same firmness of anchorage may be gained by soldering the base of the sheath to the anchor-band, which is to be firmly clamped and cemented in position upon the anchor-tooth, as shown in Fig. 283.

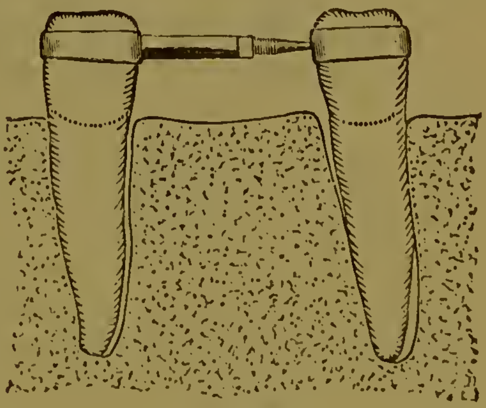


FIG. 283.

"Another way of moving teeth backward in the line of the arch is by means of Set No. 2, and will be described in the treatment of cases of excessive protrusion of the superior incisors.

"The movement of a tooth forward in the line of the arch may be accomplished by means of the traction-screw, in the same way as already described for retraction, by selecting anchor-teeth on the opposite side to be used in overcoming the resistance of the tooth that is being moved, as shown in Fig. 284, which represents a case in practice, and shows the screw employed in pulling both incisors forward in the line of the arch to close the wide space between the centrals; at the same time providing space for the cuspid, which is being moved out of inlock by means of the jack-screw. In this case the traction-screw was beaten flat, polished, and bent to conform to the curve of the arch.

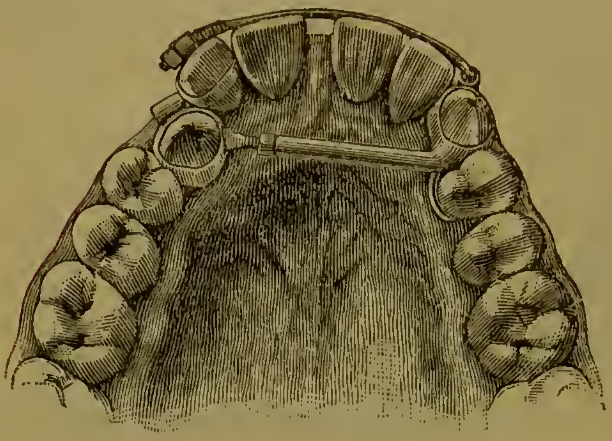


FIG. 284.

"The movement of a tooth from within outward into the line of the arch is accomplished in four principal ways: first, by means of the jack-screw E and J, Set No. 1, the sheath of which is secured to a suitable anchor-tooth, the point acting upon the moving tooth by turning the nut. The base of the sheath of the jack-screw may be secured in various ways, as shown in Fig. 285: first, by a dowel made by soft-soldering a piece of the wire G, Set No. 1, into the end of the sheath which rests in a pit in the anchor-tooth, as in A; by a spur made from the same wire soldered to the anchor-band, over which the end of the sheath is slipped, as in B; by a dowel made from the same wire, slipped into one of the pipes R, Set No. 1, soldered to the anchor-band, as in C (in this way the length of the sheath may also be increased); by pointing the end of the sheath with a file and letting the point rest in the pipe on the anchor-band, as in D; by soldering the sheath directly to the anchor-band, as in E and F; by notching the end of the sheath, which shall engage the anchor-wire as in G, Fig. 285; by soldering the end of the sheath directly to another sheath, as in H; by means of a spur made from the wire G, Set No. 1, soldered to the sheath which shall engage one of the pipes R, Set No. 1, soldered to the anchor-band, as in I; by slipping the end of the sheath over the screw upon the clamp-band, as in J. Of these various ways I prefer that of attaching the sheath directly to the anchor-band, as in E and F, or by means of the spur, as in B (the spur being quickly and easily made by soldering), by holding a long piece of the wire G, Set No. 1, between two of the fingers of one hand, while the end of the screw upon the clamp-band is grasped between the thumb and finger of the other hand, carrying it in contact with the fine point of the flame, presenting the appearance after soldering shown in K, Fig. 285, after which the wire is cut off, leaving the desired length of the spur.

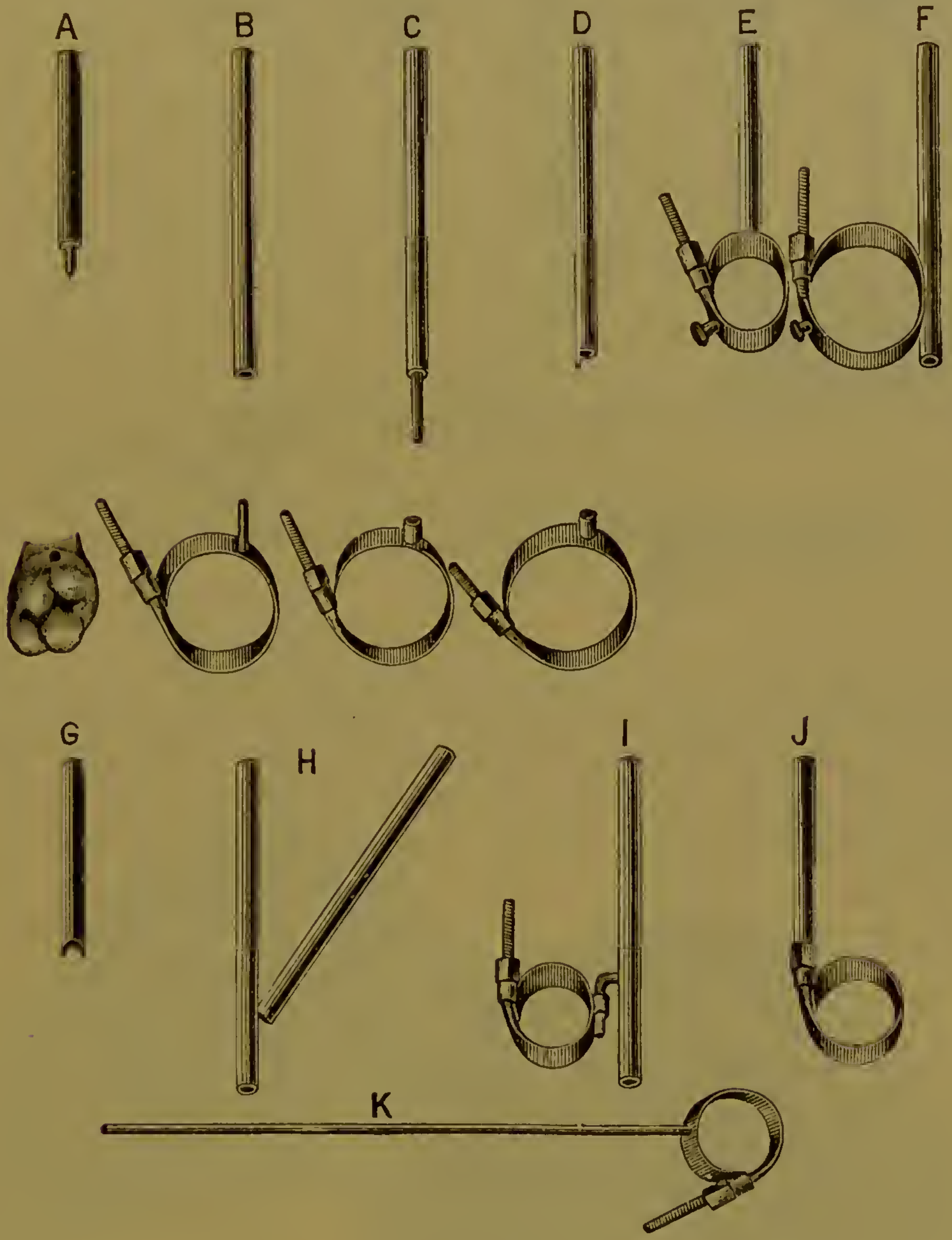


Fig. 285.

"The point of the screw is held firmly in position by six principal ways, as shown in Fig. 286. First: By notching the point of the screw with a separating file, which notch will engage a similar notch in the united ends of the band, as in A; by pointing the end of the screw to engage one of the small pipes R, Set No. 1, soldered to the band as in B; by a mortise in the band to engage the point of the screw, as in C; by soldering an elliptical ring (formed by bending the wire G, Set No. 1, as at G, Fig. 286), in which to rest the point of the screw, as in D; by a staple, made from the same wire, soldered (see H) to the band, as in E, the point of the screw being suitably notched; by pointing the screw to be received in the pit formed in the enamel or filling, as in F. Of these various ways of securing the point of a jack-screw, I prefer the plan shown in D and E, forming the ring and staple upon the ends of long pieces of the wire, which serve as handles while soldering, as in G and H, after which the superfluous portions are clipped off. The roughened ends are then rounded and made smooth with a fine file.

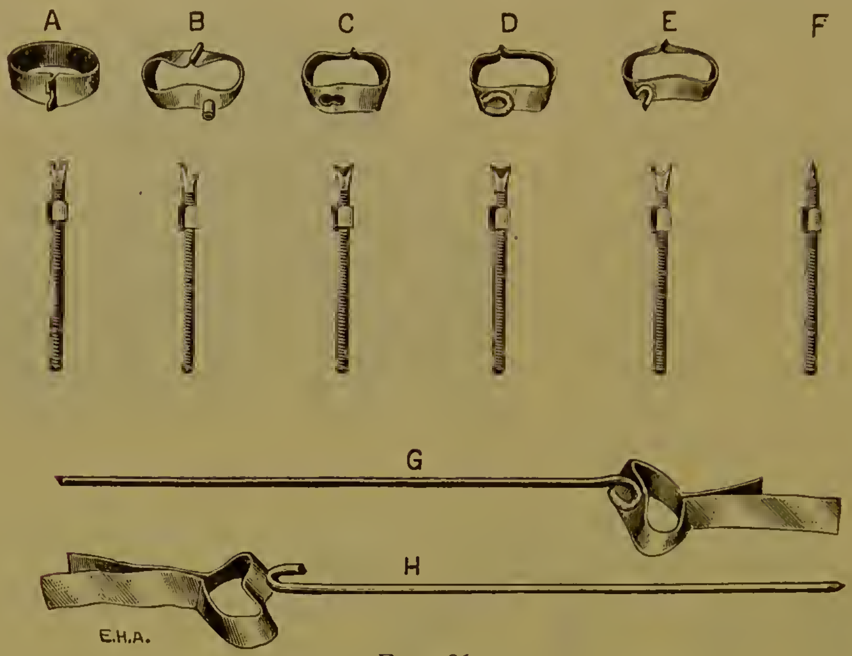


FIG 286.

"Fig. 287 shows an inlocked cuspid being moved outward, the point of the screw resting in a mortise formed in the band upon the moving tooth, the base of the sheath being notched to engage a piece of the anchor-wire G, Set No. 1, passing through a tube soldered to the lingual surface of the

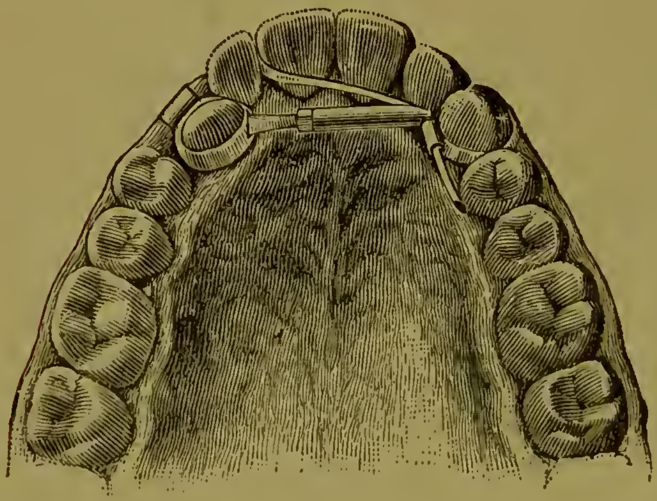


FIG. 287.

left cuspid. The anchorage is greatly reinforced by means of this wire, which is beaten flat where it passes between the central and lateral, the end being bent around the labial surface of the central. Force is obtained by turning the nut. After a tooth has been moved into the desired position, it is retained by a piece of the wire G, Set No. 1, passed through a pipe R, Set No. 1, soldered to the band, the wire ends resting upon the labial surfaces of the lateral incisor and first bicuspid. This wire is held in place by a very delicate pin passing through the pipe and one side of the wire, as in Fig. 288.

"Fig. 289 shows a favorite method of reinforcing the anchorage. In this case the sheath of the jack screw was placed on a spur soldered to a bicuspid clamp-band, as at B, Fig. 285. The point of the screw was sharpened and rested in a pit formed in the enamel. Reinforcement was gained by hooking a piece of the wire G, Set No. 1, into two pipes (R, Set No. 1), one soldered to the sheath of the jack-screw near its base, the other soldered to the lingual surface of a lateral incisor band. If the appliance has been carefully adjusted the patient may be provided with a wrench, and instructed in turning the nuts at proper intervals.

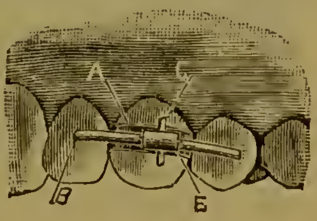


FIG. 288.

"Recent experience has proven that an easier way of attaching the reinforcement wire is to omit the pipe attached to the band on the lateral, soldering the straight end of the wire directly to the band. The other end of the wire should be passed through the pipe, on the sheath, and secured by bending the end around the pipe end.

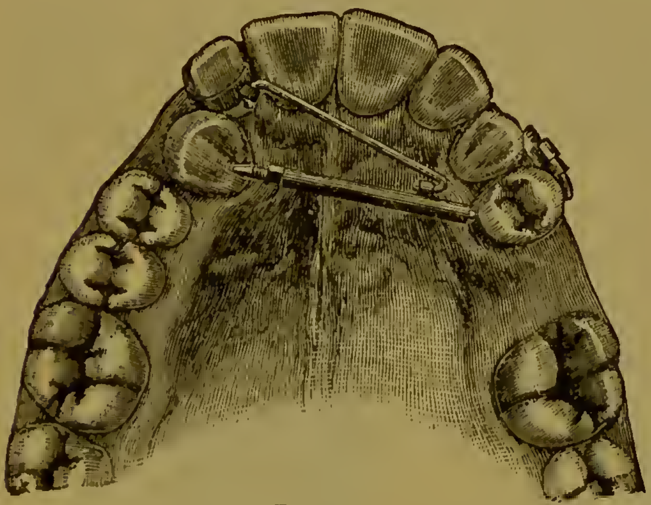


FIG. 289.

"Fig. 290 shows a left lateral being moved outward, reinforcement having been gained in the manner already described, using two pieces of wire attached to bands on the central and cuspid. Not only was the anchorage reinforced, but the incisor and cuspid were prevented from being pushed out, the moving tooth providing space for itself by forcing the adjoining teeth laterally. By this means the most perfect form of anchorage is secured, employing, preferably, the method of attaching the reinforcement wires described in the last case.

"The second mode of moving a tooth from within outward is shown in Fig. 290, where a right lateral is being forced outward by means of the small traction-screws B and C, Set No. 1. A strip of the band-material (F, Set No. 1) is looped around the lateral, the ends resting upon the labial surfaces of the adjoining teeth. On one end is soldered a short tube, C (accompanying the screw), attached vertically, while on the other end a similar tube is attached horizontally. Into these tubes the traction-screw B, Set No. 1, is placed, being bent to conform to the circle of the arch, and used, in this case, to push instead of pull. This appliance should be frequently tightened by turning the nut, or it will become loose and cause trouble. The parts of this device are shown separately in Fig. 291.

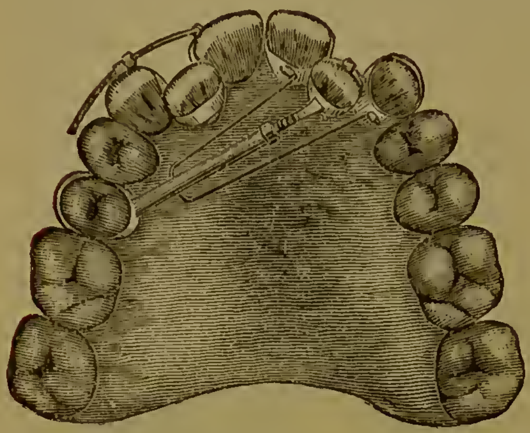


FIG. 290.

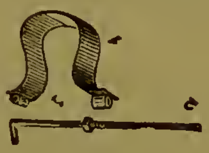


FIG. 291.

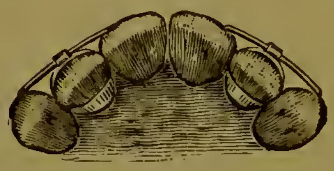


FIG. 292.

"Fig. 292 shows the teeth as retained by means of pieces of the anchor-wire (G, Set No. 1) passing through pipes attached to the labial surfaces of the bands, as described and shown in Fig. 288.

"The third method of moving a tooth from within outward is by lacing the teeth to the expansion arch, as in Fig. 293, force being derived from the spring of the arch and sustained by occasionally turning the nuts.

"The fourth method is by means of the wire ligature encircling the tooth and arch, force being exerted by occasionally twisting the wire as in A, A, Fig. 293.

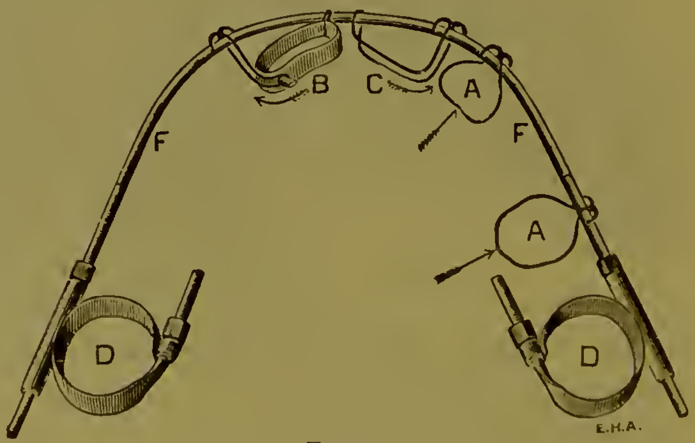


FIG. 293.

"A tooth may be moved inward by the small traction-screw B and C, Set No. 1, as shown in Fig. 294, in which a cuspid is being drawn into line, the bent end of the screw being hooked into the small tube C, Set No. 1, soldered to the band upon the anchor-tooth. The other end of the screw passes through a similar tube, against the end of which the nut works. To the tube is soldered a piece of the wire G, Set No. 1, bent at right angles and hooked into a pipe (R, Set No. 1), soldered to the lingual surface of the band on the cuspid. Force is exerted by turning the nut. The anchor-tooth was reinforced by a piece of the wire G, Set No. 1, resting in contact with the buccal surfaces of the adjoining teeth, and held in position by one of the small pipes R, Set No. 1. This anchor-wire was kept from turning by a very delicate pin passing through the pipe and one side of the wire, as in Fig. 288. Another way of securing this wire is by soldering it directly to the band.

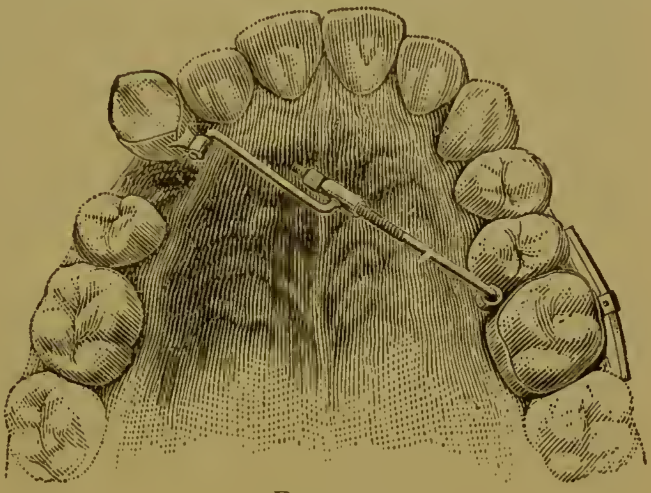


FIG. 294.

"Prominent teeth may also be forced into the line of the arch by means of the wire arch B, Set No. 2, or the expansion-arch E, Fig. 276, made to encircle the dental arch and bear against the prominent tooth, and the force may be intensified by an intervening wedge of rubber. The adjoining teeth are firmly laced to the arch by means of wire ligatures.

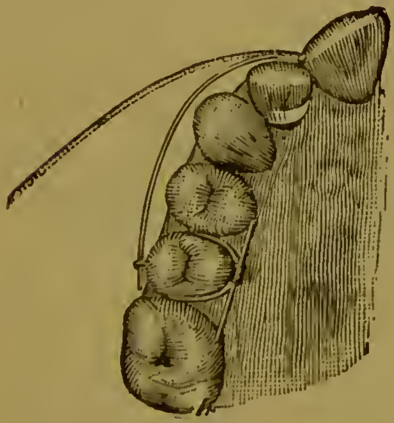


FIG. 295.—ROTATION.

"There are three principal modes of rotation by this system. First: By means of the lever, band, and tube, as shown in Fig. 295, which represents a lateral incisor in process of rotation. The incisor was cemented in position with an accurately-fitting band having soldered to it one of the small pipes R, Set No. 1, into which is inserted the end of one of the levers L, Set No. 1, the other end being sprung around and secured to a suitable anchor-tooth. This attachment of the end of the lever may be made in various ways,—either by being latched into a notch formed in the united ends of the band as shown in Fig. 295, or by a wire ligature made to encircle the anchor-tooth and lever, or by a wire ligature encircling the button on the clamp-band (No. 3 or 4, Fig. 278), and attached to the end of the lever bent in the form of an eye, which is now my favorite method. The anchor-tooth may be reinforced by a piece of the wire G, Set No. 1, resting in contact with the lingual surface of the adjoining teeth, and held in position by one of the pipes R, Set No. 1, soldered to the anchor-band as shown. It will be seen that thus a constant, powerful, rotative force may be exerted upon the tooth.

"Care should be exercised that the lever be not allowed to pry against the intervening teeth, to force the tooth outward.

"It is often desirable to lace one or more of the intervening teeth to the lever by means of the wire ligature, to prevent overlapping of the teeth. The leverage may be increased by allowing the end to pass through the pipe, and to bear against the labial surface of the adjoining tooth. This may be intensified by an intervening wedge of rubber.

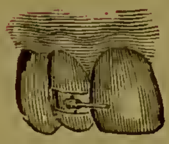


FIG. 296.—RETAINER.

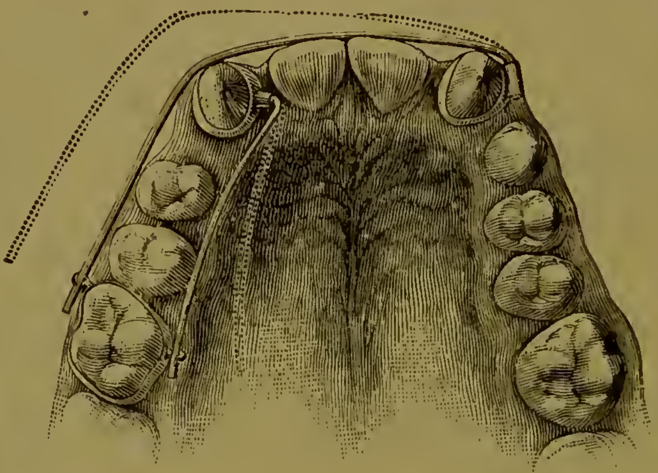


FIG. 297.

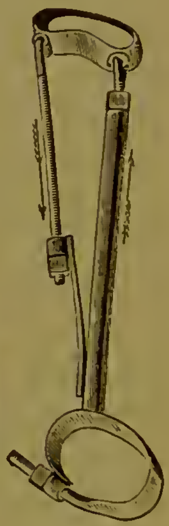


FIG. 298.

"Fig. 296 shows the rotated incisor retained by a short piece of the wire G, Set No. 1, slipped into the pipe from the opposite side and made to bear against the labial surface of the central incisor. There should also be soldered a spur to the disto-lingual angle of the band and made to bear against the cuspid.

"Fig. 297 shows two cuspids being rotated by this method. It will also be seen that the lever may be employed on the inside of the arch, and in this case there was the advantage of reciprocal anchorage resulting from the ends of the levers acting in opposite directions upon the anchor-tooth.

"In all similar cases where the lever is being employed on the outside of the arch it should be bent at the point nearest the labial surface of the cuspid, so as to concentrate all the spring in the region of the moving tooth.

"Second: Rotation may also be performed, as shown in Fig. 298, by means of the jack-screw E and J, Set No. 1, secured by staple, clamp-band, and spur, and pushing against one side of the tooth to be moved, while the small traction-screw, attached by pipe R, Set No. 1, and piece of anchor-wire G, Set No. 1, soldered to the base of the sheath of the jack-screw, is made to pull upon the other side of the tooth. In this way perfect control of the tooth is gained, not only in rotation but also in pushing it outward or pulling it inward into the line of the arch, according as the nuts are adjusted. This method of rotation is principally limited to the superior central incisors or cuspids. It should be said that because of the powerful force they exert the nuts should be turned but slightly at each sitting. This is also another instance where use is made of reciprocal anchorage, which is to be taken advantage of whenever possible.

"Third: Rotation may be accomplished by exerting force on one side of a tooth by means of a wire ligature on the expansion-arch E, and a spur soldered to a band encircling the tooth to be moved, as at B, Fig. 293. This force may be intensified by a wedge of rubber stretched between the band and arch and acting upon the opposite side of the tooth. A modification of this plan of rotation is shown at C, Fig. 293, in which the band is dispensed with and the double or loop ligature is continued around the tooth, including the wire arch. This plan is less certain on account of the liability to slip: it is also less powerful, since the wedge of rubber cannot be used. It, however, will be found useful where teeth are to be but slightly rotated. At the same time a number of other teeth should be ligatured to the arch to secure greater firmness.

"When two teeth are to be rotated in opposite directions at the same time, as the central incisors shown in Fig. 299, double rotation may be accomplished by a single lever. In this instance both the teeth are banded, and a tube soldered to each band. A straight lever is inserted in one tube, springing and sliding it into the other tube in the same manner in which a door-bolt is slid into position, as also shown in Fig. 300. It may be necessary to occasionally remove and straighten

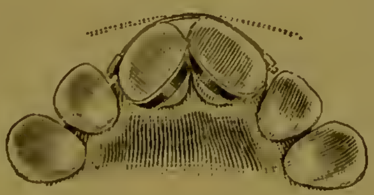


FIG. 299.

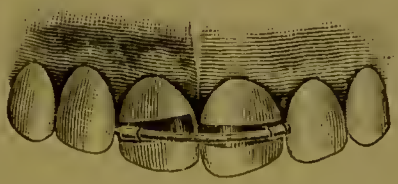


FIG. 300.—DOUBLE ROTATION.

the lever a little, in order to maintain the pressure. Should one tooth be rotated sufficiently before the other, further movement may be arrested by removing the band and soldering a lug on the lingual surface to rest against the lateral incisor. And should the teeth in rotation assume too much prominence, by reason of pressure from the adjoining teeth, it may be effectually corrected by requiring the patient to wear, for a few nights, the head-gear, traction-bar, and heavy elastic bands shown in Figs. 274 and 275, filing a deep notch in the end of the standard to engage the rotating lever.

"If the teeth show a tendency to separate as they rotate, they should be drawn tightly together by a ligature, made to encircle both tubes and held in position by the ends of the lever, slightly protruding through the tubes.

"When the teeth are in position they are retained by substituting a piece of the non-elastic wire G, Set No. 1, for the spring wire, or, better still, by uniting the bands with solder, and recementing them, as first suggested by Professor Guilford.

"Of the levers shown at L, Set No. 1, four different sizes are furnished. The smallest size is quite strong enough, in most instances, for double rotation, and is most commonly used by me, especially on the teeth of children.

"These levers are plated in such a manner as to nearly overcome the annoyance of oxidation and discoloration of the teeth in their use, thus obviating an objection to the employment of steel wire in the construction of regulating appliances.

"The reader should never confuse the wire G, Set No. 1, with these levers. Their uses are as different as the material of which they are composed. The levers are used only in rotation (occasionally in expansion), and are never united by solder in forming an attachment; while the wire G, Set No. 1, is extremely tough and malleable and has a very wide range of application, such as reinforcing anchorage, retention, making spurs, staples, etc.

"The elevation of a tooth in its socket may be accomplished as shown in Fig. 301, wherein a superior cuspid is being drawn out or erupted into line. The clamp-band No. 3, Fig. 278, was fixed on the lower second bicuspid. A very small hole was drilled into the cuspid, and a short pin was set with thin cement. A common pin answers the purpose very well, and the hole need not be deeper than the enamel if the pin is accurately fitted to it. A rubber ligature was given the patient with instructions to slip it over the pins, as shown in the engraving. The anchor-tooth in this case is directly opposed by the superior bicuspid. The anchorage is simple and efficient. The ligature may be worn at night only, so as to interfere as little as possible with speech and mastication, although some patients wear it almost continuously. Too strong a ligature should not be worn, as it might endanger the life of the pulp, but gentle traction should be used, gradually directing the tooth into its proper position. The direction of force to be exerted upon the tooth to be moved will of course indicate which tooth in the inferior arch should be selected for anchorage. Should the anchorage fall upon a tooth with no antagonist, there would, of course, be danger of loosening it.

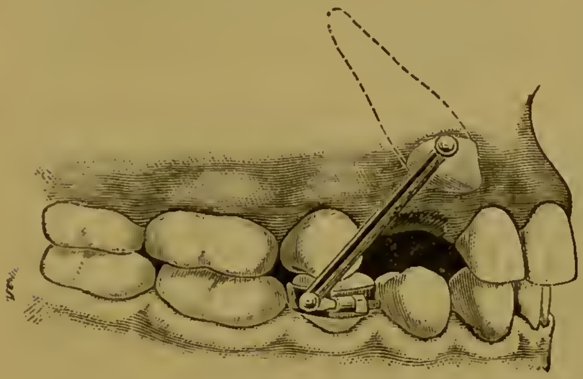


FIG. 301.

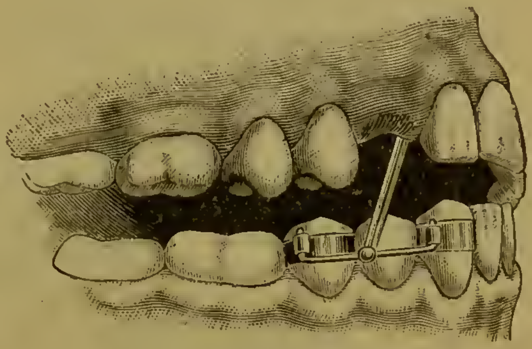


FIG. 302.

"Fig. 302 shows a case in which the anchorage was modified to suit the conditions. A deciduous cuspid had been retained too long, causing the permanent cuspid to remain in the alveolar process on the palatal side of the lateral incisor, necessitating a complex movement of the tooth backward, outward, and downward, requiring a very firm anchorage and a strong ligature. On the inferior cuspid and second bicuspid were fixed bands, having pipes R, Set No. 1, attached to their labial surfaces. A piece of the wire G of suitable length was bent at right angles and hooked into the pipes, as shown. The wire fits the bore of the pipe so accurately that in cutting off the ends which emerge through them, each end spreads sufficiently to prevent its coming out. A pin was soldered to the wire about midway between the pipes. The ligature was stretched from pin to pin, as seen in the engraving.

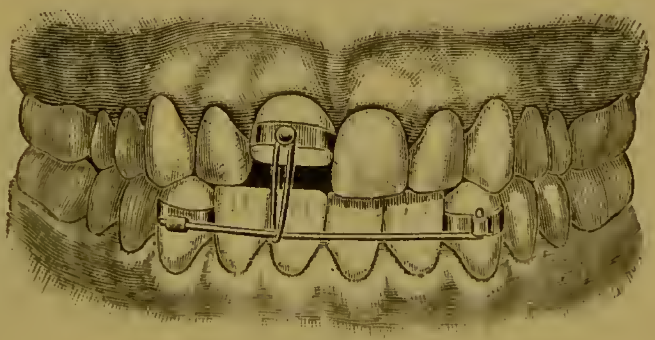


FIG. 303.

"Fig. 303 shows a modification of this method of anchorage. The anchor-wire was made detachable and the pin dispensed with, the patient slipping the wire through the ligature and into the pipes upon retiring, and removing it during the day. A delicate band (made of F, Set No. 1), to which was soldered the pin, was fixed on the moving tooth.

"Fig. 304 illustrates a case in which the appliances used were similar to those before described, but the wire anchorage was attached to teeth in the same arch in which was located the malposed tooth. The first bicuspid was banded and a pipe R, Set No. 1, soldered to the labial surface of the band, in which was hooked a piece of the wire G, Set No. 1, the other end of the wire being bent so as to rest on the cutting-edge of the lateral incisor. A pin was soldered to this wire, as in the case before described, and a rubber ligature stretched from pin to pin. In some cases where more force was necessary, I have used the combined anchorage described.

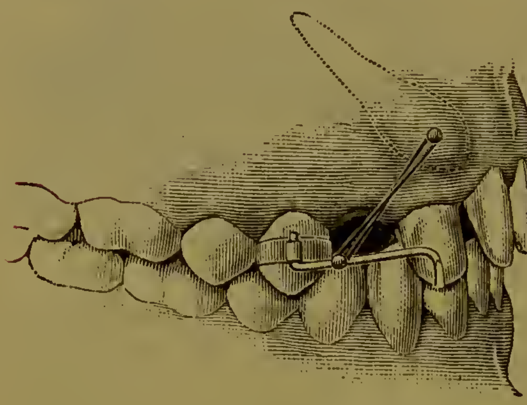


Fig. 304.

"A tooth may be elevated in its socket by employing either of the wire arches E or B as an anchorage; attaching the ligature to the tooth to be moved in any of the ways already described. Fig. 305 shows a case where all of the upper incisors are being elevated by this method. Considerable downward spring was given to the anterior part of the arch, by spurs attached to bands on the cuspids, which furnish a bearing or fulcrum for the wire arch. Force is exerted in this case by the downward spring of the wire arch after it has been attached to the moving teeth by wire ligatures or bands with spurs.

"There are several modes of expanding the arch by this system. First: By banding and tubing the first and last teeth of those to be moved on each side, and connecting them by means of wire (G) passing through the tubes. The jack-screw is then placed in position across the arch, from wire to wire. Collars R, Set No. 1, are soft-soldered to the wire at intervals to keep the screw in proper position. The jack-screw may be moved forward or backward, according to the varying requirements of the case. Before placing in position, the wires which pass along the sides of the arch should be bent to correspond to the shape of the sides of an ideal arch, or

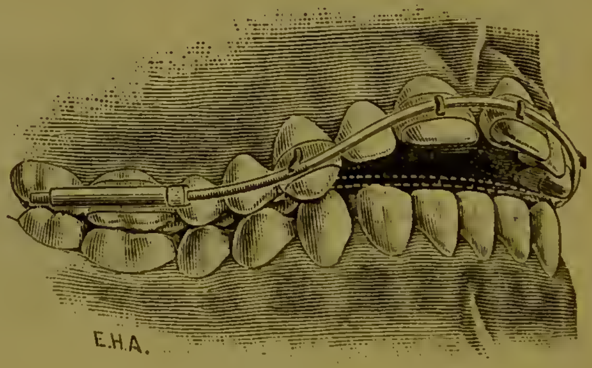


Fig. 305.

exactly as we wish the teeth to be when finally arranged. The appliances in position are accurately shown in Fig. 306.

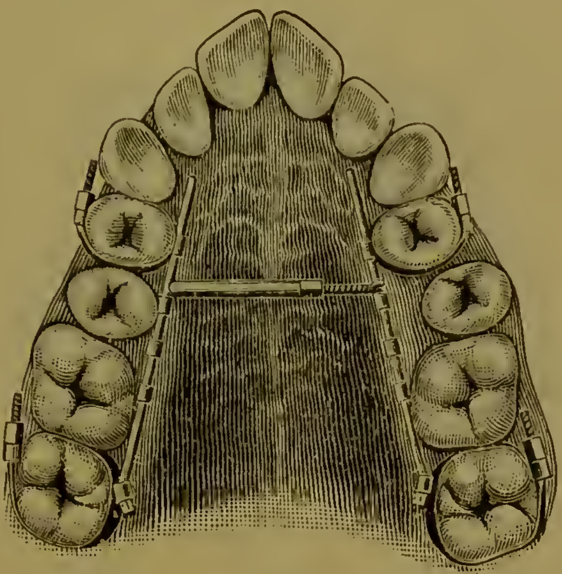


FIG. 306.

"Fig. 307 shows a modification of this method of expansion, the force being derived from one of the levers L, Set No. 1, bent in the form of the well-known Coffin spring, affording all the advantages of the Coffin method of expansion, without the disagreeable features of the rubber plate. Its chief advantage over the above method is that it may be also used in expanding the lower arch, without interfering with the movement of the tongue, as would jack-screws.

"The appliance for double rotation shown upon the central incisors has already been described, and is repeated only to illustrate how it may be used with advantage while the arch is being expanded laterally; the rubber ligature is used at the same time to retract the incisors.

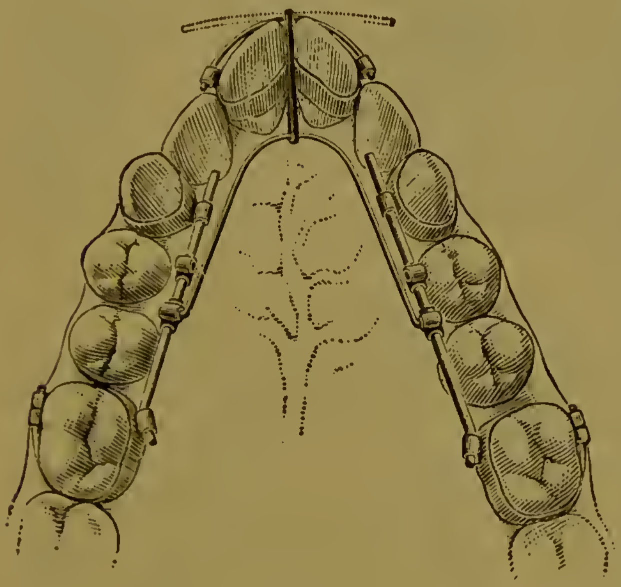


FIG. 307.

"The extra tubes, soldered at right angles to little collars slipped upon the bars on each side of the arch, are for engaging the expanding spring, should it be found necessary to transfer the pressure to that part of the arch. Should it be found necessary to move a tooth beyond this side bar, stretch a rubber wedge between the tooth and bar, as shown in Fig. 324. This simple method of moving a tooth beyond the limits of the appliance will be found valuable in connection with other parts of this system.

"Another method of expanding the arch laterally, as well as anteriorly, is by means of the appliances shown in Fig. 308, wherein the notched ends of the jack-screw engage a piece of one of the wire levers L, Set No. 1, held in position by notches formed in the united ends of the bands upon the lateral incisors. The sheaths of the screws were held by solder to anchor clamp-bands on the first molars. The incisors were moved forward by turning the nuts upon the jack-screws, while the arch was being expanded laterally, by means of one of the spring levers L, Set No. 1, the ends of which had been bent sharply at right angles, and made to engage the delicate holes bored into the sides of the sheaths of the jack-screws, all as clearly shown in the engraving. A modification of this plan is to exert pressure laterally by means of a third jack-screw instead of the spring, this screw being notched at each end and made to rest in contact with the screws upon the sides of the arch, anterior to their nuts.

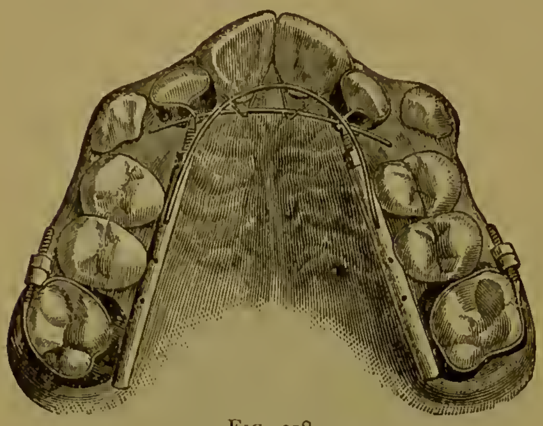


Fig. 308.

" Another excellent method of expanding the arch is by means of lacing the teeth to the expansion-arch E, shown in Figs. 274 and 276. The wire ligatures are occasionally tightened by twisting, until the teeth have been moved outward and made to conform to the shape of the wire arch. The increasing of the arch is provided for by adjusting the nuts in front of the tubes upon the anchor-bands. By this method, one or both of the lateral sides of the arch may be expanded, or the anterior part of the arch alone may be moved forward, in which case the teeth are laced to the arch and moved forward collectively by turning the nuts. (See Fig. 274.)

" In expanding the lateral halves of the arch by this method, the wire arch should be straightened sufficiently to give all possible spring, which in most instances exerts sufficient force. In cases where the teeth are extremely firm, the expansion-arch may be reinforced by the spring from one of the levers L, Set No. 1, bent to conform to the inside of the arch, and made to press upon the anchor-bands D. The ends of the wire are held in position by being bent at right angles, and slipped into pipes R, Set No. 1, which have been soldered at right angles to tubes, C, slipped

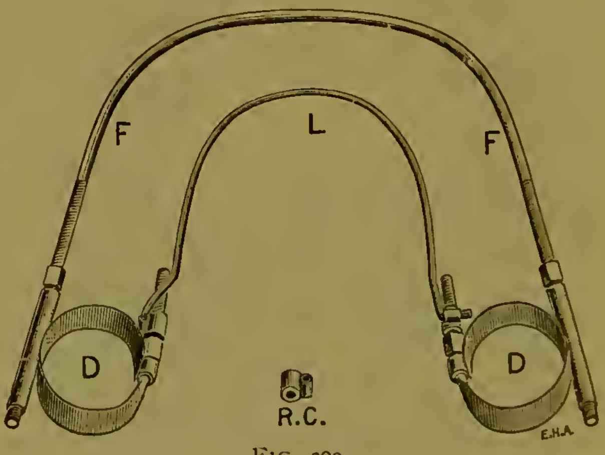


Fig. 309.

over the ends of the screw upon the clamp-bands D, all as shown in Fig. 309.

"If it is desirable to exert pressure only upon the bicuspids, the spring of L alone is sufficient, when held in proper position, by securing the ends in either of the following ways: By resting in one of the pipes R, Set No. 1, soldered to the clamp-band (the end of the pipe being closed as shown on the left of Fig. 310), the arch being bent so as to lie in contact with and also exert pressure upon the first bicuspid; or the end may be secured, as on the right of Fig. 310, by being bent to engage one of the pipes R, Set No. 1, soldered to the nut upon the clamp-band, the end of the band-screw resting against the first bicuspid. The nut must be removed from the screw while soldering, or pieces of the anchor-wire G may be soldered to the clamp-bands encircling the second bicuspids, the front ends in contact with the lingual surfaces of the first bicuspids. To these wires are soldered at right angles the pipes R, which engage the ends of the spring, as in Fig. 311. Or the same attachment to the clamp-bands upon the bicuspids may be made as already described and shown in Fig. 309.

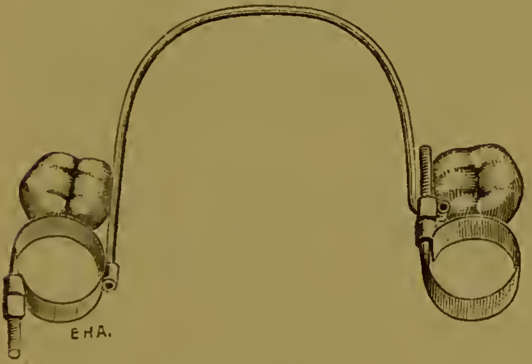


FIG. 310.

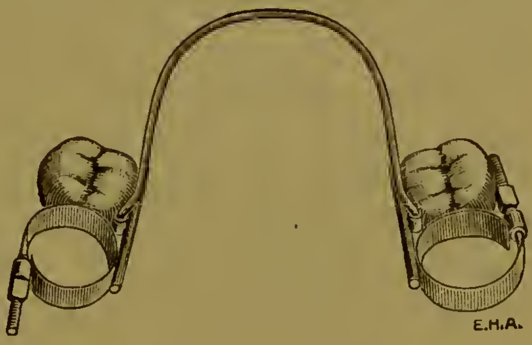


FIG. 311.

"If it is desirable to exert pressure upon one tooth only, a pipe should be soldered to the band over the tooth to be moved; in this pipe rests the end of the spring. Bend the spring so that all the force will be exerted upon the one tooth to be moved, while two or more teeth as anchorage on the opposite side of the arch antagonize this force. This latter plan will be found useful in moving outward or inward a single molar, which is sometimes desirable in order to establish perfect occlusion."

Dr. W. G. A. Bonwill in his description of his system of correctors for irregularities writes as follows:—

"1st. To commence as soon as possible after the seventh year, or as soon as there is evidence of decided irregularity.

"2d. To watch all children's teeth from the third year and determine, by an exploring needle every three months, the exact position of the coming permanent teeth as soon as the first permanent molar has appeared.

" 3d. To preserve, by early treatment, the first and second molars—temporary—even to the treatment of their pulps, if they were not brought in time to obviate it.

" 4th. To be sure the first permanent molars are preserved without loss of pulp and allow nothing to interfere with their full and free development in the arches, as upon these teeth more than any others are due the irregularity, *by coming too far forward in the arch from decay of approximal surfaces of temporary molars, or from the tardy eruption of the permanent incisors.* The sixth-year molar drives the arch into smaller space when the incisors have appeared out of or inside the arch.

"If the arch is once interfered with the area is not so great, and consequently there will be a deeper underbite and the permanent molars will move forward and always keep them so, causing the permanent teeth which are yet undeveloped in the maxilla, and lying over each other and not in line, to roll over and shorten the whole maxilla in front of the permanent molar. *Therefore,* keep this tooth as far back toward the ramus as possible.

" 5th. That all apparatus should be simple and, if possible, firmly fixed, that the patient can have no control over it, and then see the case every few days.

" 6th. That constant and uninterrupted pressure is preferable. The antagonism of the opposite jaw will always be exerting a force to make them move back and forth in the sockets, which makes sufficient intermittent pressure.

" 7th. That while one plan, without change somewhat to each case, will not do, yet the infinite number of such apparatus is a greater nuisance to patient and operator.

" 8th. Take impressions of both jaws in plaster and a duplicate from the first; that the plaster teeth could be cut off and rearranged to see the effect, and these models placed in my anatomical articulator, where they could be studied in the lateral movements, so necessary. That this should be studied carefully; and, before action is taken, have the patient call and study the case in relation with the plaster model; and if doubt existed as to the extraction of a tooth or teeth, better postpone a few days and send for patient again rather than make so great a blunder.

" 9th. That a tooth should be held as sacred as an eye; and, while extraction is sometimes demanded, when the greater good of the patient is at stake—when of weak constitution—yet do not too hastily resort to it.

"10th. That without the combined assistance of parent and child, better not commence.

"11th. That nothing should be withheld from the child or parent, but every detail, every risk, and the amount of patient endurance needed, the long time, and, when all is corrected, to allow of stay plates, that the work gained may be retained.

"12th. Not least of all the factors, I must mention (which I did not at first see) to place such valuation on the services as will insure your interest and will drive the parties concerned up to their duties.

"To these points I would now further insist on the great importance of utilizing as factors or fulcrums the temporary molars.

"1st. By shaping them with a disc on all their sides or surfaces, so that a gold clasp can be securely placed thereon. Figs. 322 and 333.

"2d. Where a ligature only is needed, to cut a groove with the disc on the buccal and palatal and lingual surfaces near the cervix, in which to place the silk ligature to keep it from working down under the gum. Fig. 332, C C.

"*These teeth will soon be lost, and no injury is done by shaping and grooving them.*

"3d. By the use of gutta-percha (Figs. 321 and 322), warmed and placed on the palatal or lingual side of the tooth, around which a ligature is to be placed and carried slightly up over the grinding surface to prevent the ligature from pressing down under the gum. This I use on permanent teeth.

"4th. Where the tooth cannot be cut or gutta-percha used, then gum sandarach varnish or a thin solution of oxyphosphate zinc placed on the tooth will prevent the ligature from slipping when the tooth is being rotated, or keep it from pressing up under the gum.

"The trouble has always been how to get hold of any of the temporary teeth as a fulcrum.

"It has been my practice for years to first make use of the silk ligature and rubber bands, without plates. To do so, how shall I prevent the ligature from slipping off the permanent tooth, and from slipping down over the temporary tooth used as the fulcrum?

"I argue that as the temporary cuspids and first molars will soon be lost after the permanent lateral incisors have come, and are high enough to get hold of, to cut a slot with a small hard-rubber disc on their buccal and palatal surfaces deep enough to hold the ligature which keeps it from ever passing down under the gum, Fig. 332. If I must make a plate of rubber or metal for the inside I use the same grooves to hold the plate in position.

"If I must have a clasp, which is now most frequently the case in the use of this new appliance, which I will presently show you, I cut the first temporary molar on its mesial and distal surfaces a little under parallel, as at Fig. 333, and the strain is so slight it is not uplifted before the lateral incisor has been drawn into the circle. If there is any danger from the ligature wounding the gum, I place underneath gutta-percha. If I want to pass a ligature around a permanent tooth (Figs. 322 and 327), as a fulcrum, I simply warm a small piece of gutta-percha and press it on the palatal or lingual side of the tooth, letting it extend slightly down on the gum, and when cold and rigid cut two holes through it to let the ligature pass, and then between the teeth, and tied outside to the rubber band. This little adjunct cannot be overpraised, for it is so soon adjusted, is pleasant to the patient, and non-irritating to the tissues. I cannot tell you how much I love gutta-percha, and especially just here to save me so much plate work and irritation, and for keeping my children in good humor. If a metal wire or band is pressing into the gums, and a hook cannot be used on the grinding surface, the gutta-percha fills the need ; and it answers well as a fulcrum by letting the band directly into the gutta-percha or by attaching it to the wire or silk ligature that holds the former.

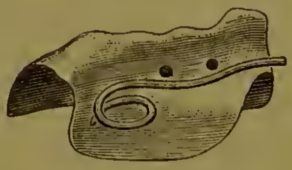


FIG. 312.

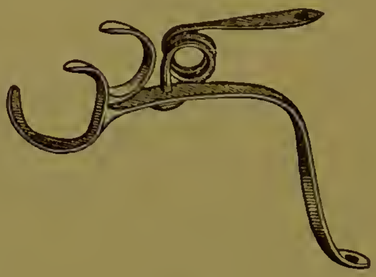


FIG. 313.

" The figures from 312 to 333 show all the appliances and their applications for irregularities. Fig. 312 to 317 show the spiral spring in various phases.

" Fig. 312 is a silver plate to fit the lower incisors tied on to a central to correct a superior central from the inclined projection on the right, and the end of spring acting on the right inferior central to throw it out of the arch.

" Figs. 313, 314, 315 are metal bands with clasps, with the spiral spring soft-soldered under a metal loop hard-soldered to the band. This retains the temper. These are used on many teeth in either jaw.

" Fig. 315 is a metal plate with half clasps fitted to the bicuspids to hold it in position. The spiral spring is soft-soldered to plate. This can be changed to various positions on plate, and is applicable to cases where it is difficult to place clasp entirely around a tooth.

"Fig. 316 was made for drawing backward the four incisors of inferior jaw with spiral springs, adjusted not to interfere with the tongue or superior teeth. The piece at A goes over the incisors and is held by ligatures tied to one or more of the teeth.

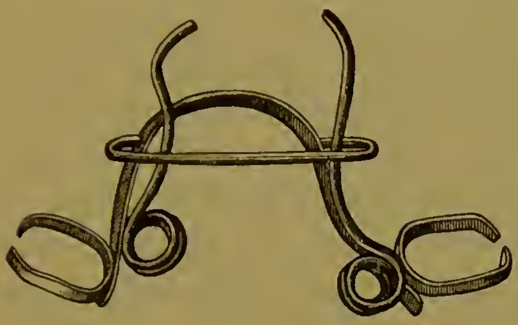


FIG. 314.

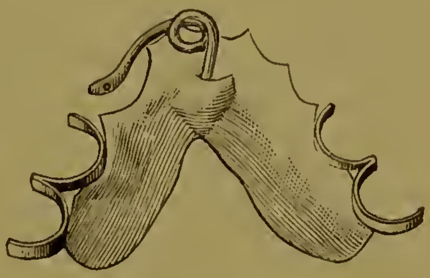


FIG. 315.

"Fig. 317 is a jack-spring for constant pressure. It may be made in a curve to conform to the hard palate. It is very powerful and effective and superior to a *jack-screw.*

"In all these spiral-spring appliances the spring is tied to the tooth to be acted upon to hold it from slipping; or, in some cases, a hole drilled into the tooth is better.

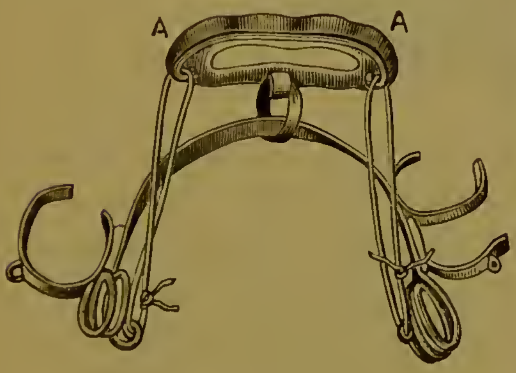


FIG. 316.

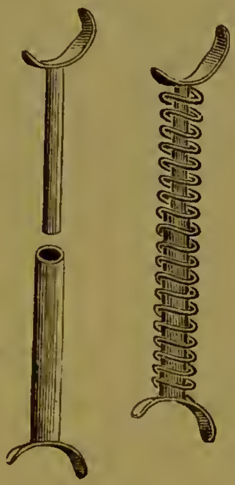


FIG. 317.

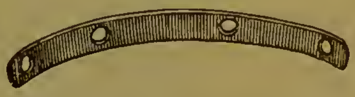


FIG. 318.—APPLIED IN FIG. 326.

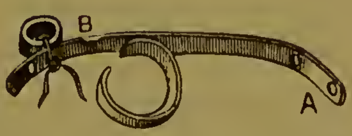


FIG. 319.—APPLIED IN FIG. 330.

"The appliances that with me have superseded all others are seen in Figs. 318 to 333. Fig. 318 is a curved bar of platinized gold with four holes punched therein for the passage of silk ligatures. It is another way of applying Fig. 319 without band and used mostly for a single tooth in either jaw. The principle of action will be seen in Fig. 326, where two inferior lateral incisors are to be drawn from within out. To do so requires expansion of the jaws. This is effected by making the holes in the end of the plate over the center of each cuspid and by carrying the silk ligature from the mesial side of the laterals around back and up between the lateral and cuspid and through the hole in plate at either end, and attached to a rubber band which is stretched between the holes. This pushes the cuspids backward or opens the arch, and the centrals move forward somewhat, and the laterals easily fill the breach. Once in position and they are retained without apparatus.

"If the holes through which the ligatures pass were made exactly opposite the laterals, no good would be effected, because the pressure would be as much down as out, and compressing the arch. But the ligatures applied as directed force the jaws apart, although the band is resting hard on the cuspids. The ligature is a loop or slip-knot, and must be applied so as to come out between the lateral and cuspid. Gum sandarach varnish will keep it from slipping around the tooth. The band, as heretofore applied, has not expanded the arches, because the holes were not in the right places—over the cuspids.

"Fig. 319 is this same bar with a clasp on one side of the arch. The bar is lengthened beyond the clasp to allow of the *rubber tubing tied at* B being attached far enough away from A for getting power.

"It is applied, Fig. 330, by clasping a first molar. The right central has to be twisted and the lateral also, but in the opposite direction. The bar rests upon the mesial buccal edge of the lateral while the silk ligature is carried *twice* around the central, bringing it up next the lateral and over it through the hole in the bar in the point where it rests on the lateral and is now drawn through the rubber band which has been tied opposite the molar. The rubber is stretched to the full length of the bar. The cuspid was also drawn outward on the same bar by boring a hole directly opposite, which can be made to twist the cuspid as well as to draw it outward.

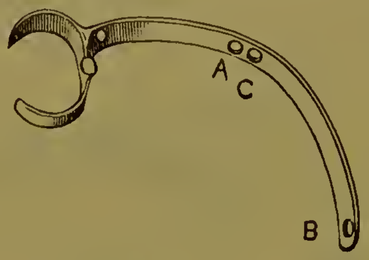


FIG. 320.—BAR SHOWN AS APPLIED, FIG. 322.

FIG. 321.—APPLIED IN FIGS. 322 AND 327.

"Fig. 320 is the same bar applied to Fig. 322 for drawing out both superior laterals and expanding the arch. The right cuspid is just emerging and the first bicuspid is clasped. The ligature with a slip-loop is carried over the right lateral, coming up from its distal side and through the hole in bar at A, and tied to the rubber band near the first bicuspid. The left lateral is ligated the same way, coming up through the hole at B, which is over the centre of cuspid. The ligature pressing the left cuspid backward is tied to the rubber band at C. Where the bar is too short to stretch the rubber band, it can be lengthened on one side of the clasp or carried back to the right bicuspid.

"The lower jaw partially shows the application of the gutta-percha stay-plate (see Fig. 321) for keeping the ligature from off the gum at cervix, on the first molar. The lower jaw being too large an arch for the upper, I extracted the first right bicuspid, and as the right lateral inferior incisor was too far in the arch, and the right cuspid very far outside, I simply ligated the first inferior molar on the same side. A piece of pink base-plate gutta-percha was warmed and pressed up against the molar, letting it rest partially on the adjoining teeth (see Fig. 321); when cold, two holes were made in it for the passage of the ligature, which was tied on the buccal surface of the molar. A rubber band was tied to the inside before adjusting. A ligature is now cast around the right lateral, carried up between it and the cuspid, and over it through the space where first bicuspid was extracted, on the lingual side of the first bicuspid, and tied to the rubber band attached to the gutta-percha stay or helmet on the first molar, and stretched over the buccal surface of the cuspid. This drew the lateral out very forcibly. The ligature was lastly placed on the cuspid alone, and remained for six weeks without change.

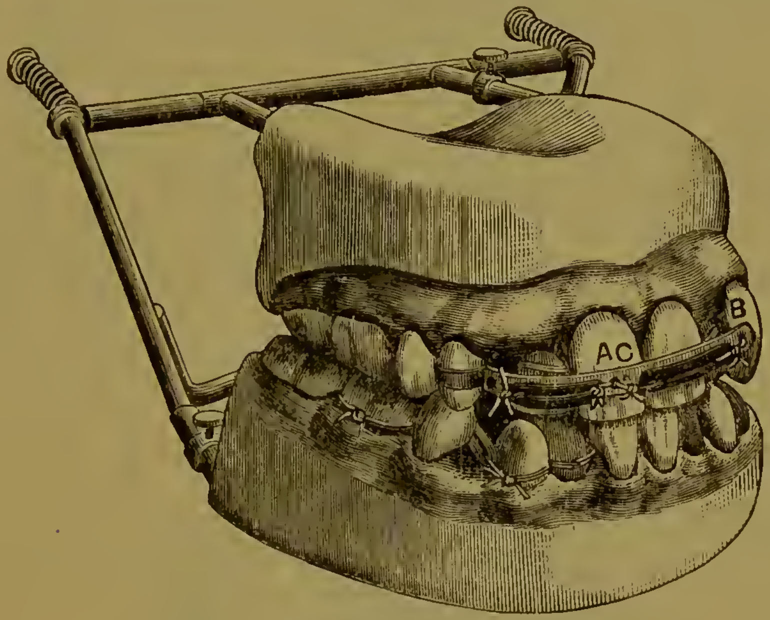


FIG. 322.

"Fig. 321 is also applied in Fig. 327. This was a very contracted lower arch with a deep underbite. The arch was first expanded by the fixture shown in Fig. 323, made of piano wire, with half clasps of platinized gold at A A, made with small ears to rest on the grinding surfaces of the first bicuspids to prevent slipping down upon the gums. These clasps are soft-soldered to retain the full temper of the piano wire as a spring. It is a very cheap and easy way of making such an apparatus and with a powerful spring, which such cases demand.

"In this case I could not afford to extract any teeth, because the incisors were already touching the gums on the palatal side of the superior centrals. In expanding the lower arch I obviated this deep over and underbite. The left lateral was very far inside the arch, and the cuspid so far as to nearly allow the bicuspid to touch the lateral. The silk ligature was now placed over the lateral and carried up next the cuspid. The first bicuspid was ligated with a stay-plate or helmet of gutta-percha on its lingual side, with the ligature running through both holes and carried around the first bicuspid and tied on buccal side. This prevented entirely the slipping of ligature upon the cervix. A rubber band was now stretched between the lateral and bicuspid and secured. This expanded the arch in front and drew out the lateral in a very short time. Had to change once for a broken or slipping ligature. These little gutta-percha caps or helmets work admirably and are not worn or displaced in mastication.

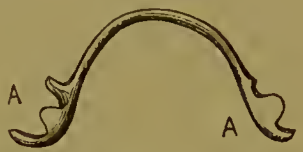


Fig. 323.—Applied to Fig. 327.—Expander of Bicuspids, Lower.

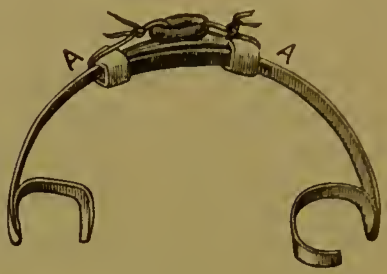


Fig. 324.—Shown as Applied, Fig. 325.

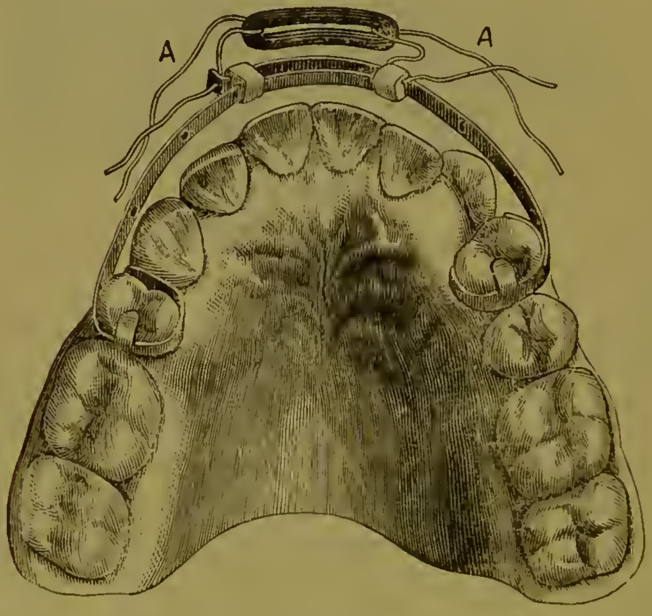


Fig. 325.

"Fig. 324 is another modification of Fig. 320, or single bar, and is applied in Fig. 325, where the four superior incisors are to be moved forward from one-fourth to three-eighths of an inch and the whole arch expanded to meet the more perfect and larger arch in the lower. It is made of two flat bars of platinized gold sliding over each other for at least two (2) inches. A loop is soldered to the end of each flat bar as guides to hold them in place while sliding through. A rubber band is shown attached to the end of each bar at A A, which, in contracting, enlarges the circle and consequently not only throws out the incisors, but the bicuspids and cuspids as well.

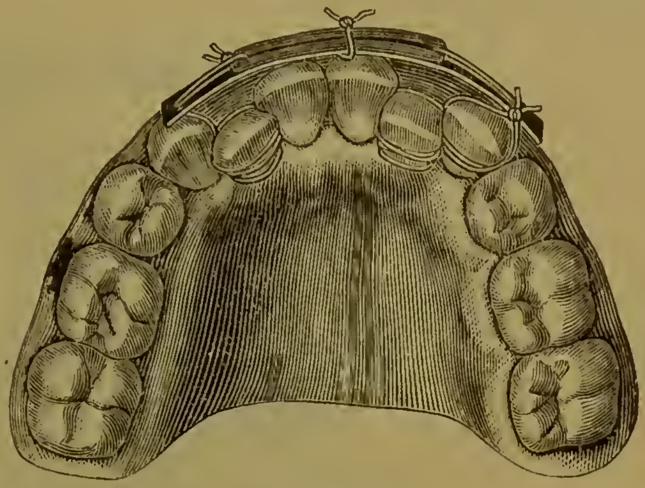


FIG. 326.

"The attachments are made on either side to a molar or bicuspid, owing to the ease of clasping. I have utilized the decay on anterior surface of a molar by filling with amalgam and cutting a hole into it for one end of the bar to rest, instead of a clasp.

"The apparatus is shown applied in Fig. 325, with the bars some distance away from the incisors to be attacked.

"Before the apparatus is placed permanently in position the four incisors are ligated with a loop, as shown in Fig. 332, using gum sandarach varnish to prevent slipping or turning on the tooth. The ligature should be so adjusted as to twist the tooth if needed while drawing it forward. These are now tied to the sliding bars, bringing them closely in contact with all the teeth in the arch. The rubber band is now tied between the two points A A, and the application is complete. It is easy to see not only its simplicity but its great effectiveness. It can be used equally well for contracting an arch.

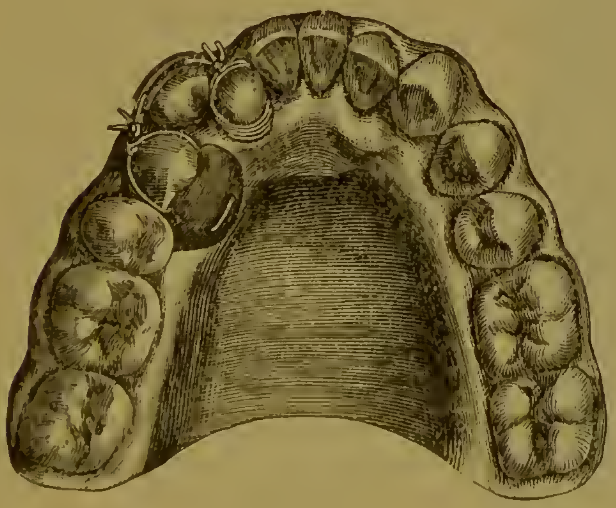


FIG. 327.

"Fig. 328 shows the worst case of protrusion of the upper jaw I ever saw. It was not done by an acquired habit, nor did it have any precedence in heredity. The temporary teeth had proper arches. No cause could be assigned. They came as you see in Fig. 328. The lower incisors, when I first saw the case, were three-eighths of an inch from the superior incisors on their palatal surface, and were imbedded into the gums on the hard palate.

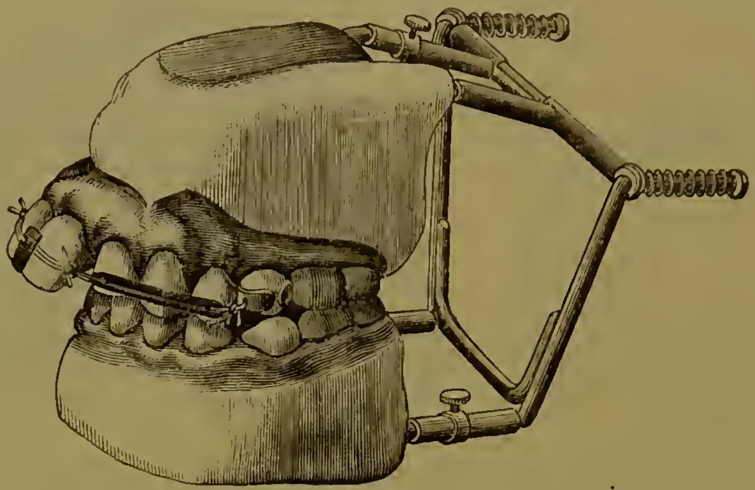


Fig. 328.

"Before attempting to draw in the incisors I made a rubber plate (Fig. 329) to cover the hard palate, thickened where the lower teeth would touch, and opened the jaws at the bicuspids at least one eighth of an inch. This was not only to drive the inferior incisors up further into their sockets, but to allow the bicuspids and molars to come down and antagonize before the plate was removed.

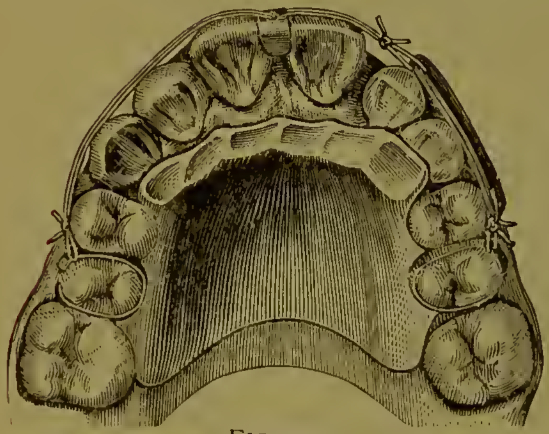


Fig. 329.

"Two years were consumed in this. To this plate I now attached a rubber band carried entirely around the arch, with a silk ligature, and at the central incisors I made a metal hook, carried over their cutting edge, with two holes through which the ligature passed. This kept the ligature down on the incisors near the cutting edges, and while it was aiding in drawing in the arch it did another important thing: forced the centrals up into the alveolus. This was done by the tendency of the rubber band to work up toward the gums, and at the same time it pressed them up and made them shorter without grinding. This was a parallel case with the one delineated by Dr. Kingsley in "Oral Deformities," but without any of the treatment given there. The sliding band in Fig. 324 would have done well here, but I adopted the simpler one of ligature and rubber. To secure it a gold band running over the arch from the second bicuspids, which was soldered to clasps around the latter, which could be adjusted or removed by patient.

“The rubber plate was removed as soon as I commenced to draw the incisor into the arch, to give room for them to fill a smaller arch. Fig. 331 shows the application of the band in the lower jaw, where the temporary molars are still in place. The permanent laterals are far inside the arch. The temporary cuspids also remained. The first molar has had all its sides squared to retain a clasp. A platinized gold bar, similar to Fig. 320, with clasps, is used, with a hole at the end of bar C; and then opposite the right central incisor, with another over the centre of the right temporary cuspid at G, and the fourth hole at the end of bar near the first molar at B.

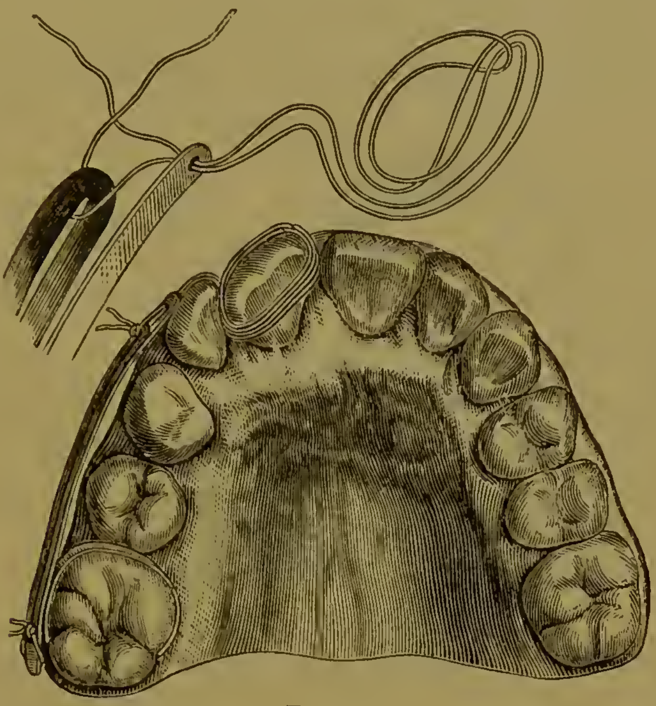


Fig. 330.

“The principal feature about this is, aside from the bar, the cutting so heroically the temporary molars for retaining the plate. This does no injury, and if it was likely to, they would soon have to be extracted for the bicuspids.

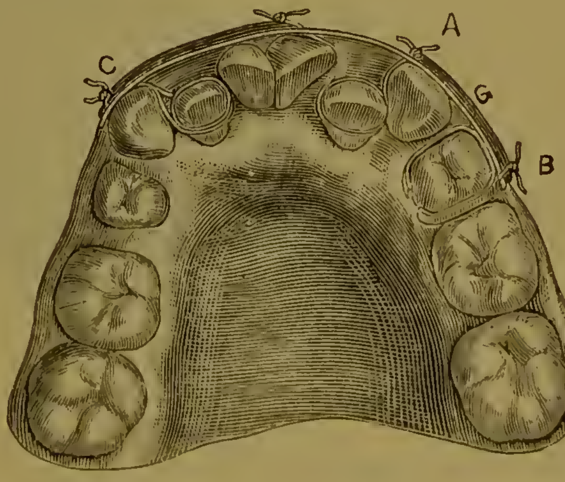


Fig. 331.

"The ligatures are applied as in all former cases of this bar, so as to press backward as well as drawing outward. In this case two separate pieces of rubber band are used.

"Fig. 332. The feature about this case which makes it novel and unique is the utilization of the superior temporary cuspids for holding the ligature. To place a ligature on the temporary teeth insures their removal or extraction without this plan. To keep the ligature on the body of the tooth I take a small hard-rubber corundum disc and make a groove on both the labial and palatal sides of the cuspid, deep enough for the ligature to rest securely. If necessary, I should do it to the first or second temporary molars, if a ligature could be gotten around the incisor to be turned into place.

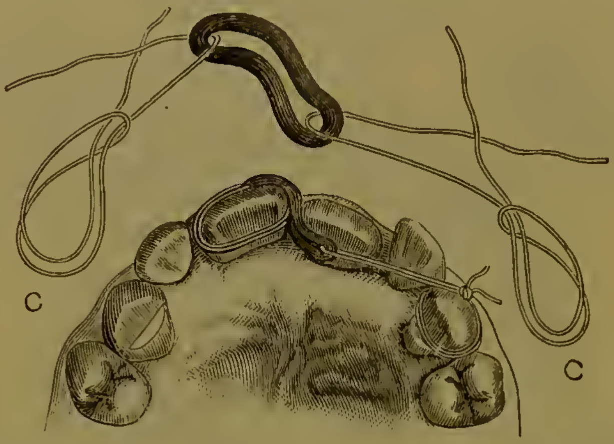


FIG. 332.

"The rubber band is drawn through and between the centrals, which gives it more power over the incisors. The left superior lateral was soon placed in the arch.

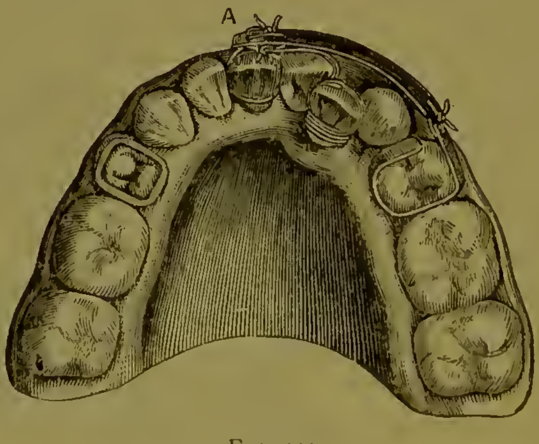


FIG. 333.

"Fig. 333 shows the cut surface in first temporary molar on the left and as applied on the right with the clasp around it attached to the bar. The ligature passes between lateral, over central, and through hole in the bar at A, pressing central to the left and molar to right."

CHAPTER II.

TREATMENT OF DENTAL CARIES.

THE treatment of dental caries is one of the most important operations in dental surgery, because of the usefulness of the organs to be saved, the universality of the disease, also the complex and difficult nature of the treatment required. The caries may be slight and superficial, or it may be more or less deep-seated; lastly, it may penetrate even to the pulp-cavity. The difficulties of treatment increase in the same order, and in this order they will be taken up. Caries, when superficial, may be arrested by the same means used for deeper caries; but in a large number of cases it will require for its removal only the use of files, enamel chisels, or discs. These instruments are also often used preparatory to the operations necessary for the arrest of deep-seated caries; hence their use demands our first consideration.

Such instruments as enamel chisels, discs, etc., have, in a great measure, however, superseded the file for the permanent separation of teeth and the removal of superficial caries.

TREATMENT OF SUPERFICIAL CARIES.—There is no operation in dental surgery against which a stronger or more universal prejudice prevails than that of filing the teeth, yet, when judiciously and skillfully performed, it often proves beneficial in arresting the progress of caries. Although productive of much good, it is, in the hands of unskillful operators, a source of incalculable injury.

In filing the front teeth and those on the right side of the mouth, the operator should stand to the right and a little behind the patient, in order to steady the head, as it rests against the back of the operating chair, with his left arm, while with the fingers of the left hand the lips are raised and the teeth properly exposed for the operation. In filing the teeth on the left side of the mouth it may be necessary for the operator to stand upon the left side of his patient. The file, firmly grasped between the thumb and middle finger of the right hand, with the end of the forefinger resting upon its outer end, should be moved backward and forward in a direct line, as any deviation from this would immediately snap the instrument. The first opening between the teeth, when the approximal edges of the two are carious, should be made with a flat file about one-fourth of a line in thickness, cut on both sides and both edges; this done, a file cut on one side and both edges should be employed for the completion of the operation. If only one tooth is decayed the operation may be commenced and completed with a safe-sided file. The file, during the operation, should be frequently dipped in tepid water to prevent it becoming heated or clogged while in use; especially should the water be warm or tepid where the teeth are sensitive. When the files become so much clogged that the water or a brush will not cleanse them, a brass or steel scratch-brush may be used, or they may be dipped in sulphuric or chlorhydric acid, and then washed with the greatest care, to remove every trace of acid.

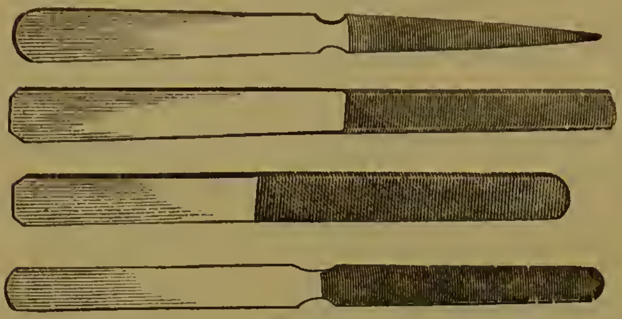


FIG. 334.

Fig. 334 represents various forms of thin separating files.

Fig. 335 represents forms of flexible separating files.

To secure the success of the operation it is sometimes necessary to cut away a considerable portion of the tooth; but in doing this the operator should be careful not to destroy the symmetry of the labial surface. The aperture anteriorly should only be wide enough to admit of a free oblique or diagonal motion of a safe-sided file of about one-fourth of a line in thickness, or a correspondingly thin corundum disc. In this way one-fourth or more of a tooth may be removed without materially altering its external appearance. But a tooth should

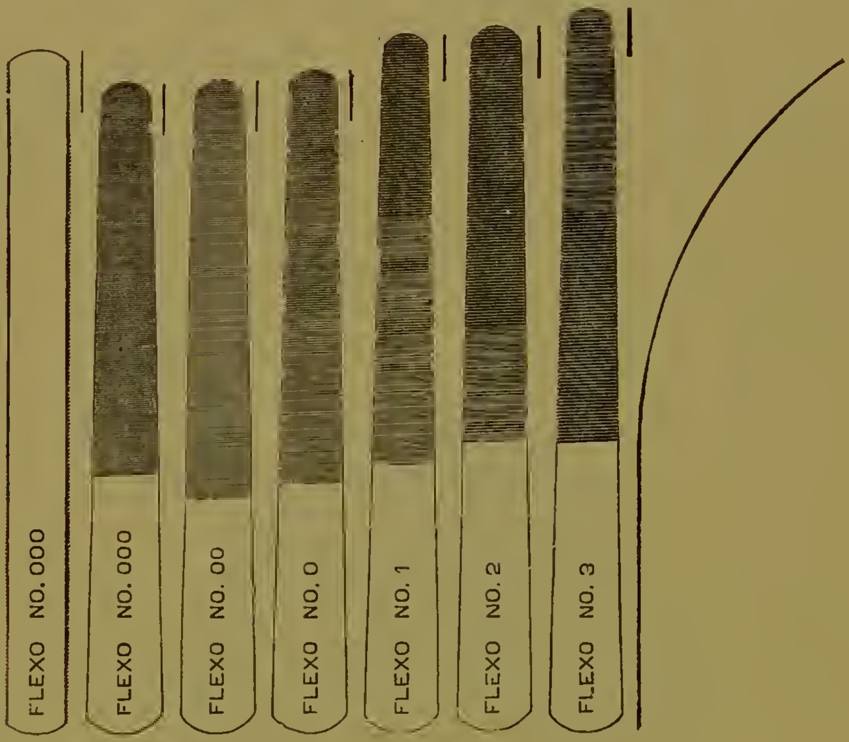


FIG. 335.

not be filed entirely to the gum; a shoulder should be left, to prevent its approximation to the adjoining tooth. Sometimes the decay is of such size and so situated that it may be removed by means of enamel chisels with less alteration in the external or labial surface of the tooth. These very valuable instruments will also be found useful for rapid cutting preparatory to the slower action of the file. A rounded form can be given by them to the inner angles of the teeth, for which purpose they may either follow or take the place of the file.

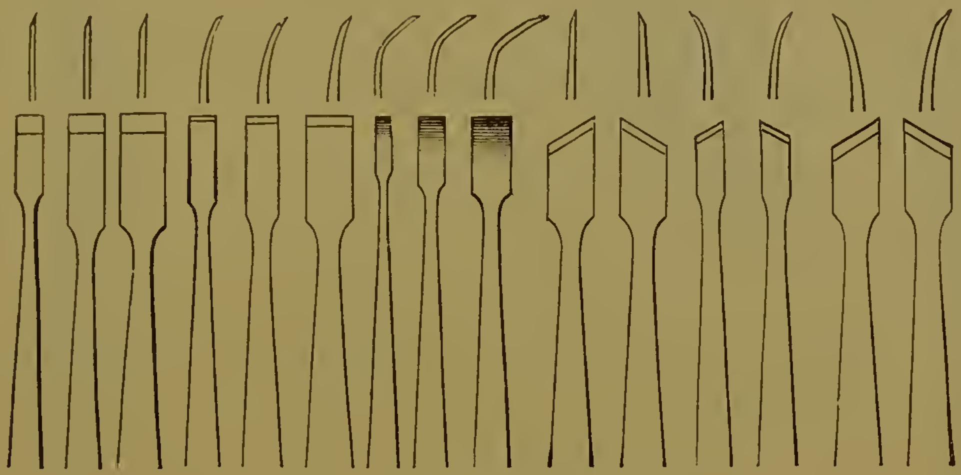


FIG. 336.

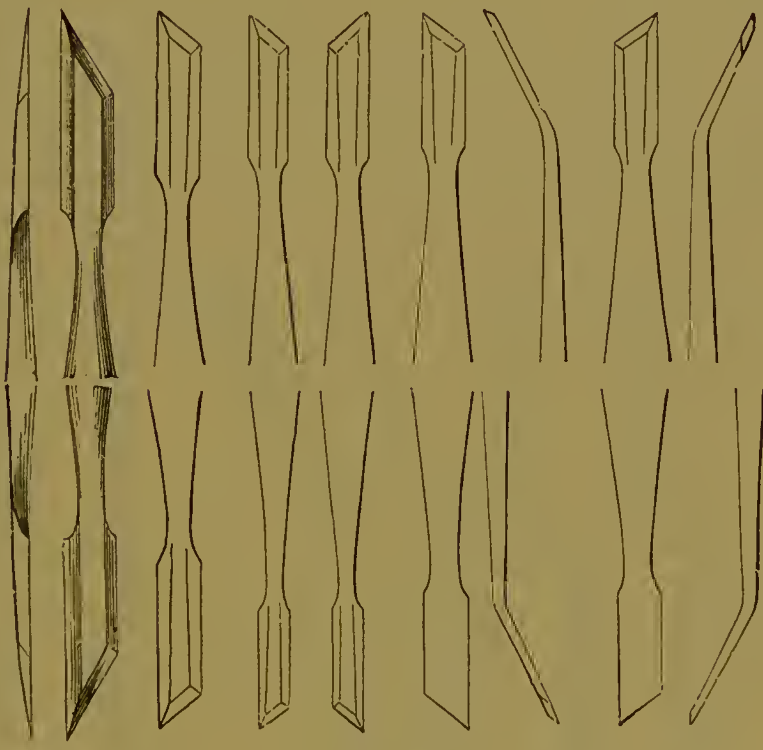


FIG. 337.

Fig. 336 represents a set of enamel chisels, straight and curved, by which the operation of removing a portion of the crown of a tooth can be performed much more rapidly than by the file, and also with more comfort to the patient.

Fig. 337 represents a set of Dr. Louis Jack's Double-end Enamel Chisels.

Fig. 339 represents Dr. W. W. Evans's set of Enamel Chisels.

When operating upon the front teeth with the enamel chisel, the instrument should be firmly grasped in the hand, near to its cutting edge, and the edge applied to the surface of the portion to be removed, while at the same time the point of the thumb uses as a fulcrum the cutting edge of the tooth or the one adjoining.

For operating upon the bicuspid and molar teeth, heavier enamel chisels are required than in the case of the front teeth, and with either straight or oblique cutting edges. The curved form of chisel is useful when the mouth is small and it is difficult to reach the point desired with the straight form.

Fig. 338 represents Dr. Gordon White's fixed blade separator for immediately separating teeth without loss of substance. It is manipulated by forcing the thin portion of the blade between the teeth to be separated, then pulling outward slowly and firmly, with a little swaying motion, until the proper space is obtained. The force so applied tends to spread the teeth outwardly, the reverse of the keystone action of the ordinary wedge, and thus a wider space is very easily obtained.

When the decay occupies a large portion of the approximal surface and has penetrated into the tooth to a considerable depth, destroying the enamel anteriorly and causing it to present a ragged and uneven edge, it will be necessary to form a wider exterior aperture than mere regard for appearance would dictate. When the approximal surfaces of the two front teeth are affected

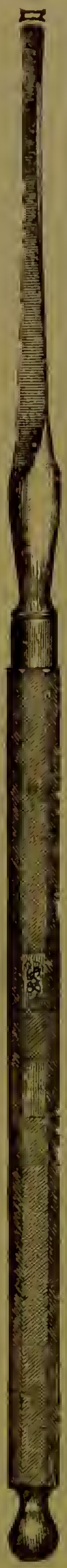


Fig. 338.

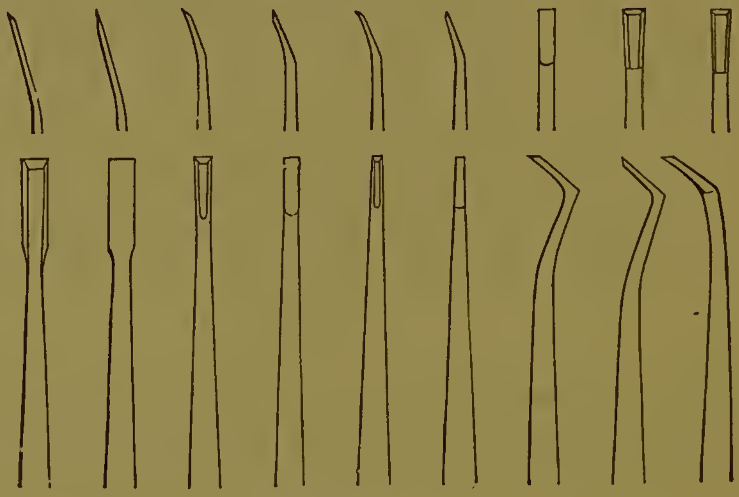


Fig. 339.

with caries, about an equal portion should, if circumstances permit and it is necessary to cut away tooth substance, be filed or cut from each tooth. In the case of delicate front teeth, or teeth slightly loose in

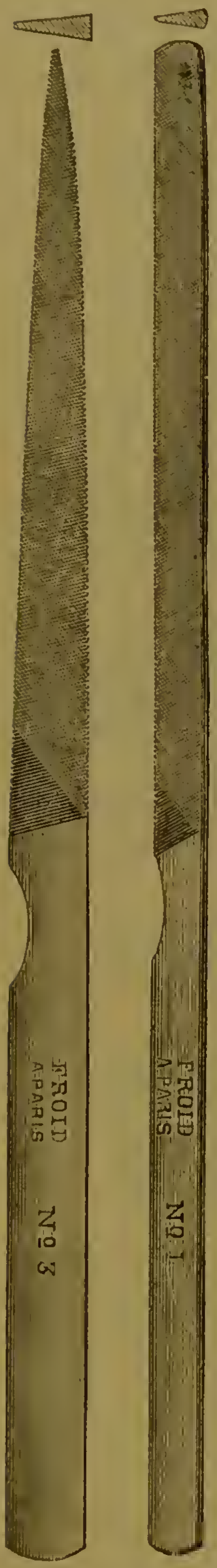
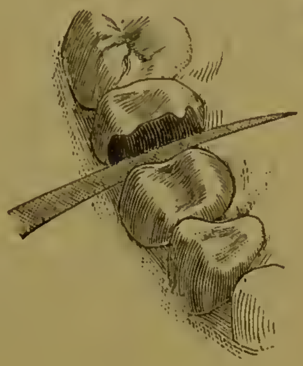
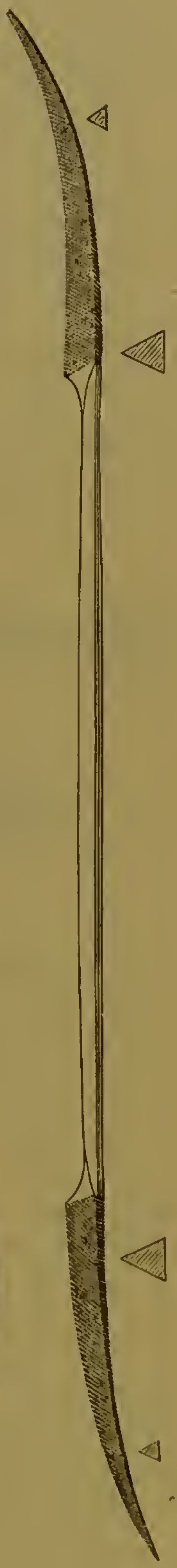


FIG. 340.

FIG. 341.





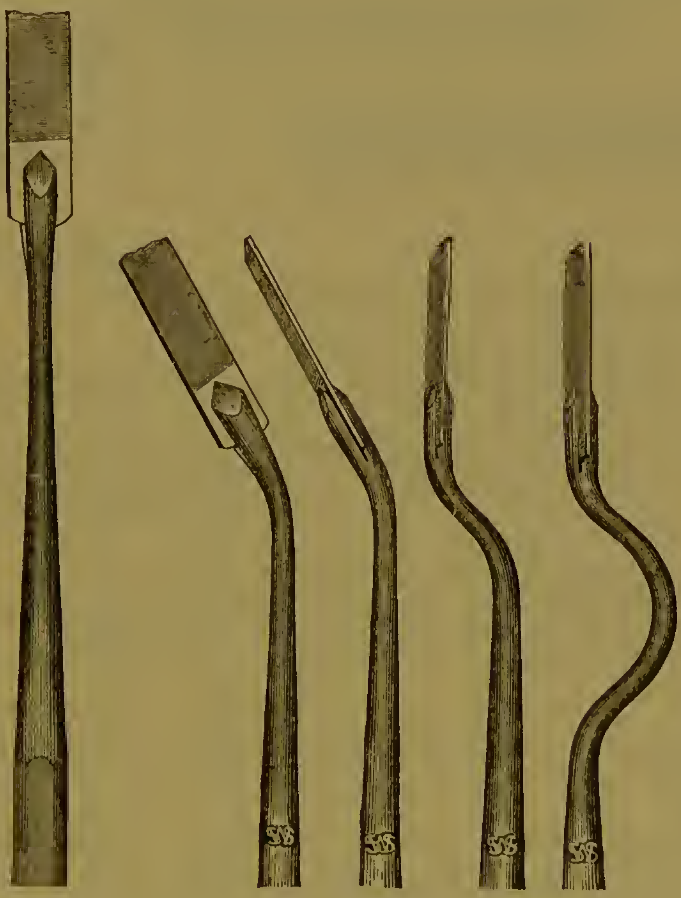


FIG. 342.

their cavities, it will be well before filing to mold a small piece of gutta-percha or modeling composition around or against the inner surfaces of the tooth to be filed and several adjoining ones. It gives support to frail teeth, and greatly lessens the danger of irritation from the motion imparted by the file to the teeth which are not firmly set in their sockets. Some use for this purpose plaster; but we think the gutta-percha or modeling composition, as suggested by Prof. Gorgas, will be found altogether more conveniently applied and more agreeable to the patient.

When the file is employed for separating the superior incisors and cuspids, the operation may be completed with a bevel-edged file, as no sharp angle should be left near the gum.

In separating the bicuspids by filing, a space should be made somewhat in the form of the letter V; it should not, however, form an acute angle at the gum. This space should also be slightly wider toward the palatal and lingual surfaces. For its formation a V-shaped file, which is one beveled on both sides, will be found most suitable. A space shaped in this manner will prevent the approximation of the sides of the teeth, and if filling be necessary, it will enable the operator to do it in the most perfect manner.

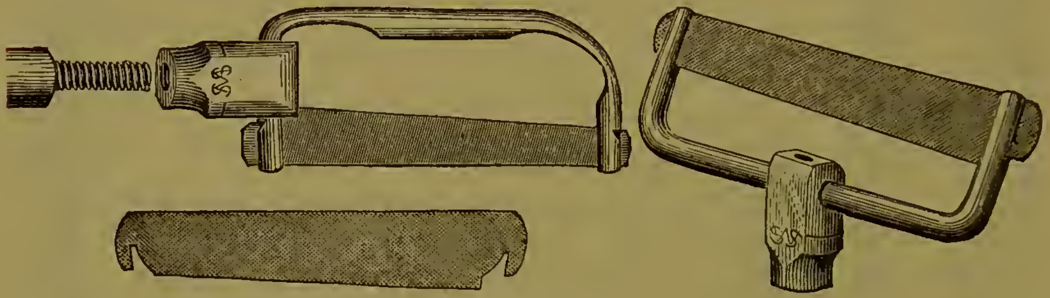


FIG. 343.

Fig. 340 represents knife-edge or bicuspid-pointed and blunt files.

Fig. 341 represents a file designed by Dr. E. Parmly Brown for contouring the approximal surfaces of molars and bicuspids. It is three-sided and cut on all sides.

When the separation of the molar teeth in this manner becomes necessary the same shaped space should be formed. But as these teeth are situated far back in the mouth, it cannot often be done with a straight file; to obviate this difficulty, an instrument with which every dentist is acquainted, denominated a file-carrier, is usually employed.

Fig. 342 represents Dr. J. E. Line's file-carrier, which is simple in its construction as well as very serviceable.

Fig. 343 represents Dr. W. B. Miller's file-carrier, which admits of changing direction and slant very quickly.

Fig. 344 represents a cheap and simple file-carrier, the device of

Dr. D. M. Clapp, either straight or curved, which will carry a thin separating file, and also finer ones for cutting metal.

A file-carrier attachment for use with the dental engine has also been devised, but it is not so readily controlled as the hand instrument.

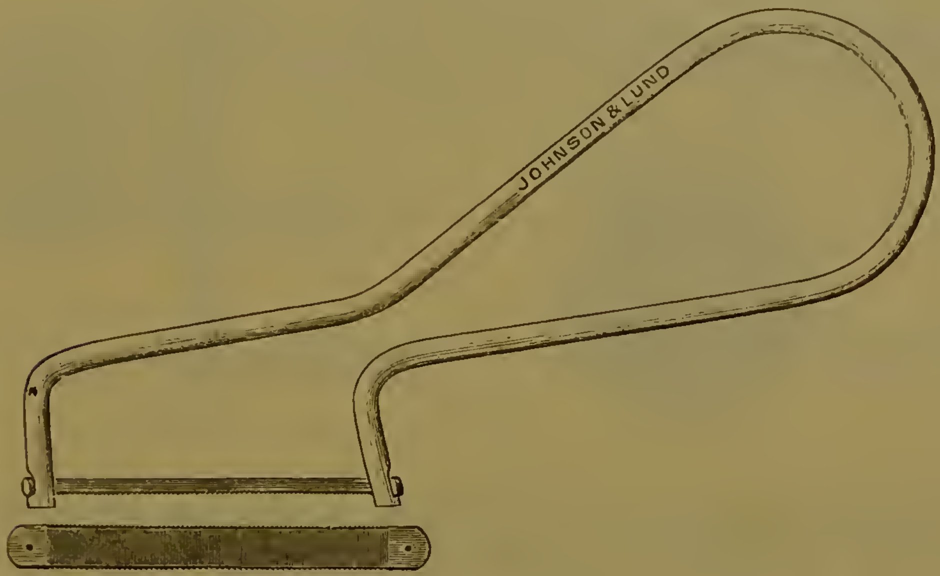


FIG. 344.

A great variety of **V**-shaped separating files are now to be found in the dental depots, from English, French, and American manufacturers. Fig. 345 will give a correct idea of some of these shapes.

Discs composed of different substances, and attached to mandrels, for use with the dental engine, are employed for separating teeth that are affected with superficial caries on their proximate surfaces, and also for removing superficial caries from such surfaces. Figs. 346 and 347 represent the diamond disc, composed of a thin plate of metal, such as nickel, in which diamond powder is thoroughly incorporated. The corundum discs, Fig. 348, introduced by the late Dr. Robert Arthur, of Baltimore, are now used, to the almost entire exclusion of files, in separating teeth, especially *molars and bicuspids*. Although often

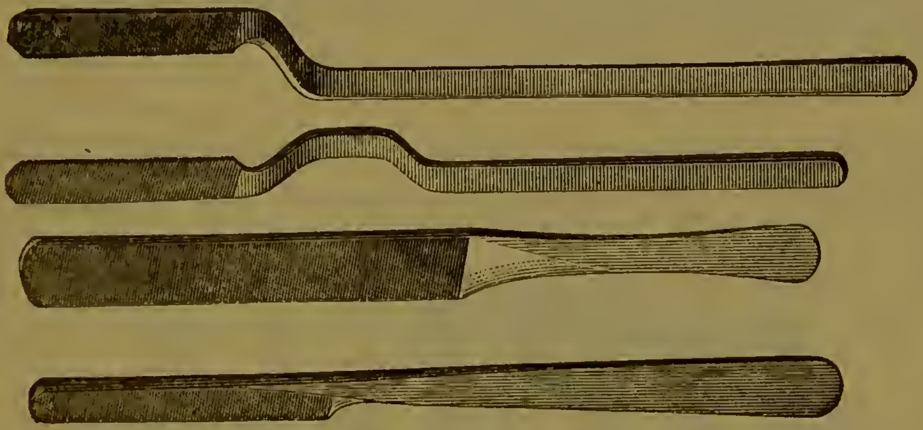


FIG. 345.

employed for separating the incisor teeth, they require careful manipulation for such delicate operations, on account of being less readily controlled than the chisel or file. The incisor teeth, being much smaller than the posterior teeth, should never be cut in the same proportion. When the disc is used for separating the anterior teeth the greatest care should be exercised to avoid too much cutting, especially of the labial angles.

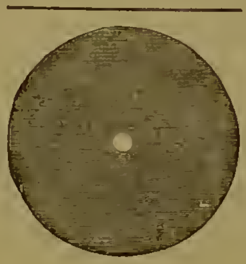


FIG. 346.

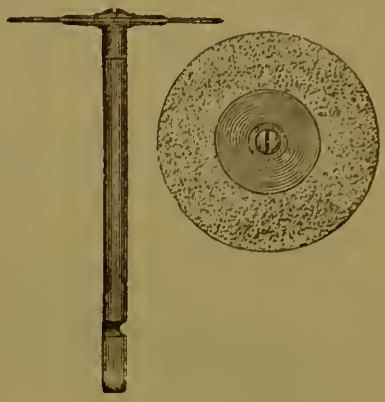


FIG. 347.

These discs are similar in composition to the ordinary corundum wheels used for grinding porcelain teeth, being composed of emery powder and gum shellac, which, being softened by heat, is rolled into a great variety of shapes to suit the different operations to be performed by them. The discs thus formed are mounted on mandrels (Fig. 350) for use with the dental engine, an instrument which will hereafter be described.

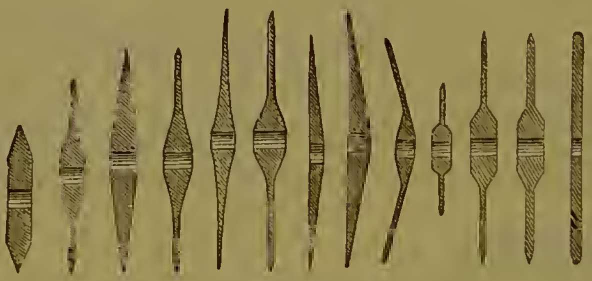


FIG. 348.

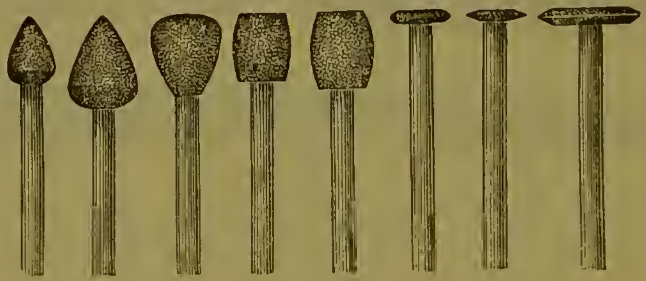


FIG. 349.

Fig. 349 represents a few forms of Dr. A. L. Northrop's corundum points for cutting and polishing.

Fig. 350 represents different forms of mandrels, with and without shoulders, for mounting corundum, diamond, rubber, celluloid, boxwood, emery-paper, sand-paper, and cuttle-fish paper discs and points.

After a sufficient portion of the tooth has been cut away the surface should be made as smooth as possible, with a very fine or half-worn file, or with Arkansas, Hindostan, or Scotch stones, wood polishing points, discs of soft or hard rubber, boxwood, felt, emery, sand or cuttle-fish paper, carrying powders such as pumice, silex, emery, buckhorn, corundum flour, Hindostan, Arkansas, etc., etc., or with tape charged with such powders.

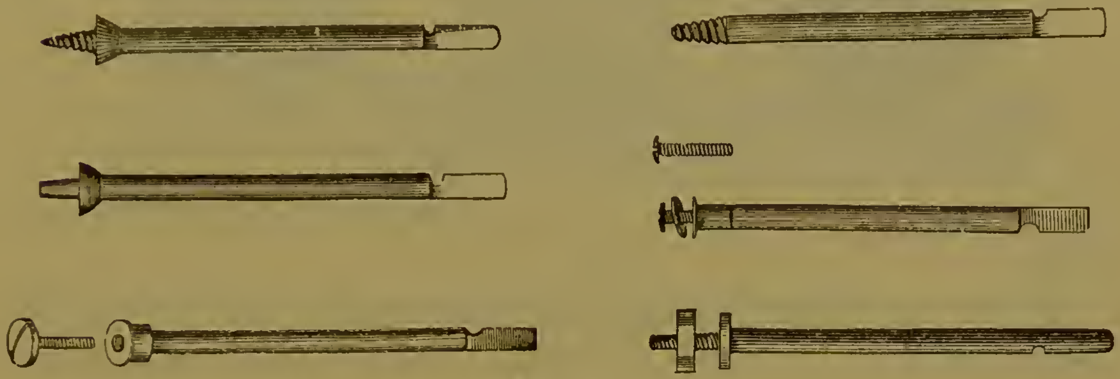


FIG. 350.

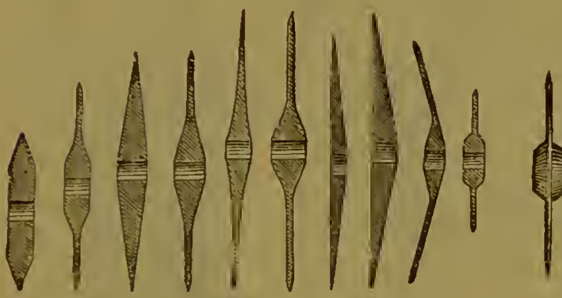


FIG. 351.

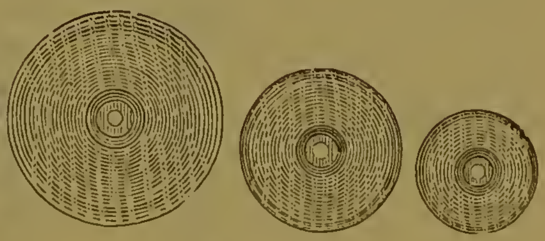


FIG. 352.

Fig. 351 represents hard rubber discs for carrying powders for polishing the natural teeth and finishing fillings.

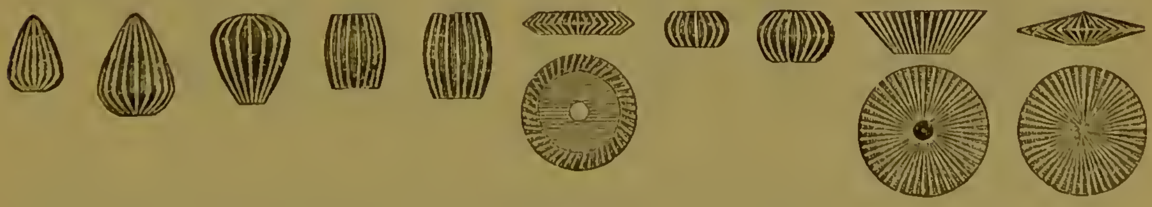


FIG. 353.

Fig. 352 represents boxwood discs.

Fig. 353 represents corrugated soft rubber discs and points for carrying powders for polishing.

Fig. 354 represents emery, sand, and cuttle-fish paper discs.

Fig. 355 represents points of Arkansas, Hindostan, and Scotch stones, mounted on mandrels, for polishing the natural teeth and fillings.

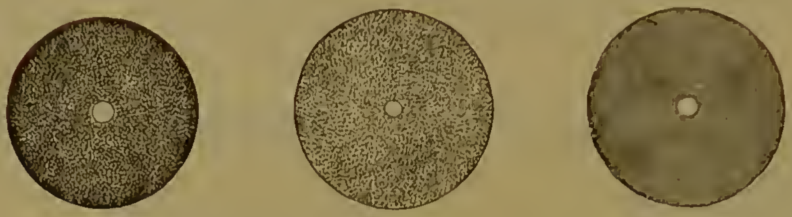


Fig. 354.

Fig. 356 represents wood polishing points, which are screwed into a mandrel for use with the dental engine. These points are also serviceable for removing discoloration from the teeth, such as results from depositions of calculus.

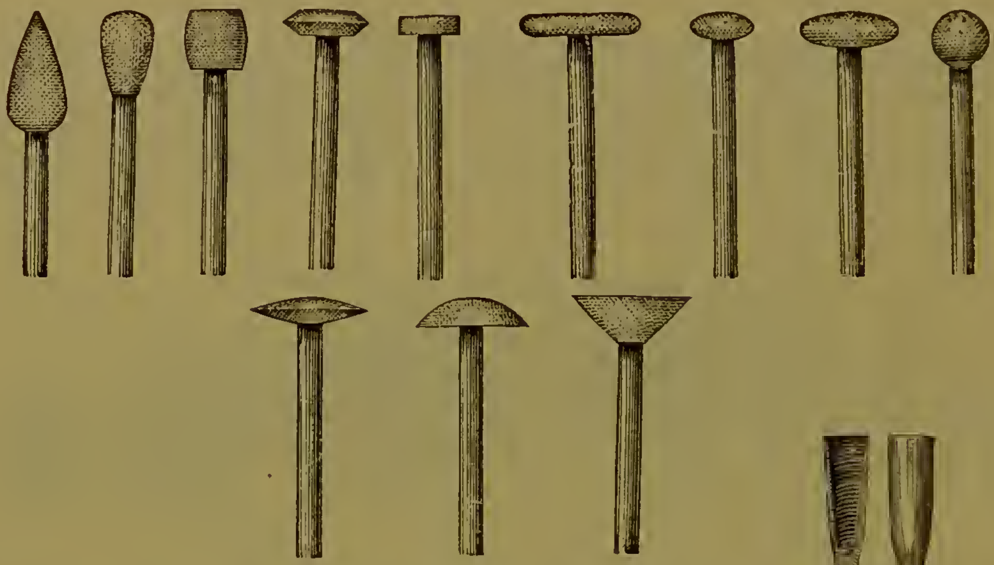


Fig. 355

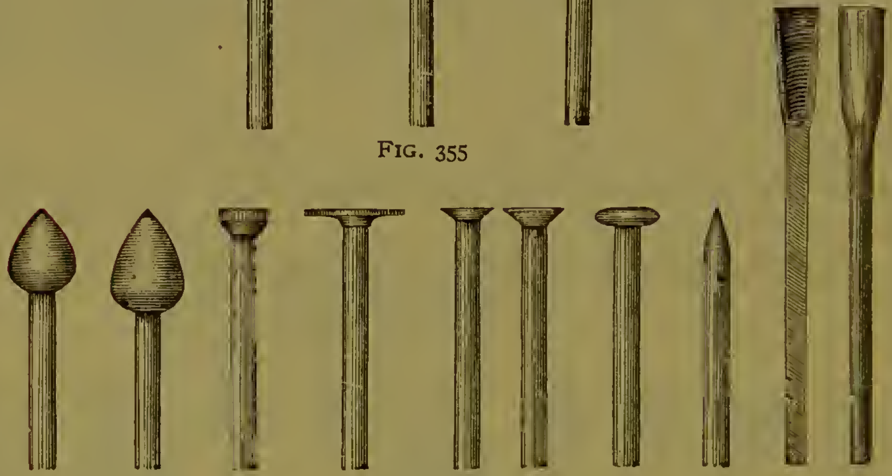


Fig. 356.

Dr. George H. Cushing's Changeable Angle Disc Carrier, Fig. 357, is easily attached and removed from the dental engine hand-piece, its angular range being indicated by the dotted lines.

A fountain mouth protector (Fig. 358), while protecting the tongue and cheek from injury, serves also to keep the disc wet. A supply of water is stored in the rubber bulb of reservoir B, by compressing and immersing it in water, and is fed as required through the small aperture seen in the cuts by a touch of the finger on the bulb. The tube A is sprung over the hand-piece, and may be turned for use in any part of the mouth.

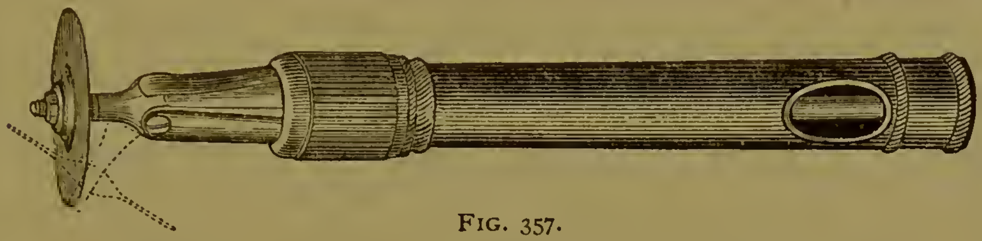


FIG. 357.

Fig. 359 represents Dr. F. Herrick's fountain drip-point, intended for keeping up a continuous dripping of water upon corundum points, engine burrs, and other rapidly revolving instruments.

When removing superficial caries all edges and sharp corners should be rounded and made smooth, and when the operation is completed the patient should be directed to keep the excised surfaces of tooth-structure perfectly clean, for if the secretions of the mouth or extraneous matter be permitted to adhere to such surfaces a recurrence of the disease will take place. Prior to removing superficial caries from the approximal surfaces, and especially of the front teeth, such teeth may be separated by pressure made with wood, cotton, tape, or rubber, so that unnecessary cutting of enamel may be avoided, and but little more of the tooth-structure be removed than the decalcified part. When a portion of the approximal surface of a tooth is cut away, the excised surface should be left free and exposed to the friction of the tongue and lips, which will prevent food and other extraneous matters, as well as the secretions of the mouth, from lodging and remaining in contact with it. The portion cut away should be as much as is possible from the posterior part of the approximal surface, especially in

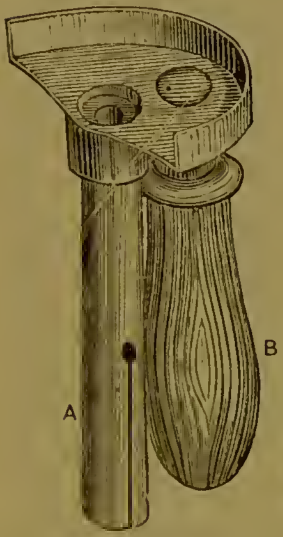


FIG. 358.

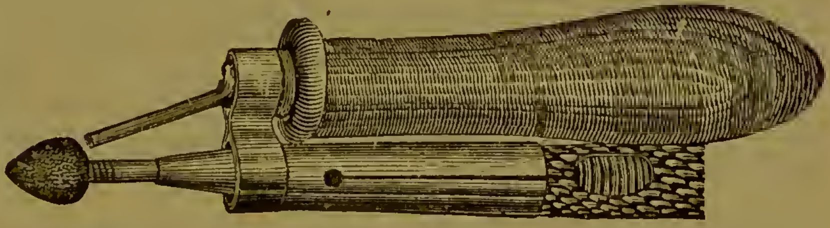


FIG. 359.

the case of the front teeth, so as to prevent any noticeable disfigurement. When superficial caries is located on the approximal surfaces of the bicuspids and molars, and near to the grinding surfaces, it may be removed by cutting out a **V**-shaped space between such teeth. When enamel chisels are employed for removing superficial caries, the instrument should be grasped near its cutting edge, which should be applied in the line of the enamel fibres, using the adjoining tooth as a fulcrum for the thumb, in order to prevent the instrument from slipping and wounding the soft part adjacent. Having in such a manner removed the overhanging enamel, the softened or decalcified dentine should be cut away with a scoop-shaped excavator, the use of which will also determine the depth to which the caries has penetrated, and if not too extensive, the enamel chisel can again be employed until the surface is made level or uniform. All edges and sharp corners should be rounded and made smooth, and it may be necessary, in order to complete the cutting process, to use a curved fine-cut file. Corundum discs operated with the dental engine may be found more convenient for the removal of superficial caries, and especially in the case of the bicuspids and molars, to be followed by strips of emery cloth or paper of the fine grades; also discs of fine sand-paper. When a perfectly smooth and normal surface is obtained, it should be highly polished with pulverized pumice or silex applied on linen tape, or on discs of flexible rubber, boxwood, or celluloid, completing the operation with polishing putty (peroxid of tin). The corundum and Arkansas or Hindostan stone points, followed by the use of wood points for the application of the polishing putty, will be found useful for removing superficial caries from exposed surfaces. When the operation of removing superficial caries is completed, the patient should be directed to keep the excised surface of tooth-structure perfectly clean. Caries upon the approximal surfaces of the teeth may be prevented by occasionally polishing such surfaces and passing floss silk between the teeth in connection with the use of the tooth-brush.

Since the introduction of the dental engine the removal of superficial caries and the preparation of the excised surface can be very effectively performed; and it should be remembered that such a surface should be left self-cleansing, so that deleterious substances may not lodge and remain in contact with it.

For separating the teeth to obtain space for the free use of the instruments employed in preparing and filling cavities on the approximal surfaces, the reader is referred to the "Treatment of Deep-seated Caries."

Separation of the Teeth.—Before a cavity can be prepared in the approximal surface of a tooth, it is usually necessary to separate it from the adjoining one. This may be done either with a file, enamel chisel, corundum disc, or by the pressure of some interposed elastic substance, or by wedges of wood driven between the teeth, or by metallic wedges or separators. Each of these methods has its advantages. When caries has extended over nearly the whole approximal surface, so that after the removal of the diseased part the orifice of the cavity will be surrounded by a thin, brittle, and irregular wall, the former is the preferable method, especially in individuals having a decided scorbutic tendency, or who have suffered from the use of mercurial medicines or syphilitic disease, and in aged persons. But when the caries has spread over only a small portion of the surface of the tooth, and is surrounded by sound, healthy enamel, the latter method should be adopted, especially in individuals in whom there is no manifest tendency to inflammation or sponginess of the gums and in young subjects. The manner of separating teeth with cutting instruments has been already described; it will only be necessary, therefore, in this place, to offer a few remarks on separating by pressure, which was first adopted by Dr. Eleazer Parmly.

The following are its advantages, where it can be resorted to with safety: after the removal of the pressure the teeth almost immediately come together, leaving no space to injure their beauty; what is of still greater importance, the dentine around the external surface of the filling is not exposed to the action of the secretions of the mouth, or other agents capable of exerting upon it a deleterious action. On the other hand, some are of opinion that when the teeth come together again a lodgment is afforded to corrosive agents, upon the presence of which the disease was, in the first instance, produced, and which would soon cause a recurrence of it. In replying to this objection it is only necessary to observe that the parts of teeth first attacked by caries were the points in contact with each other, where the enamel may be supposed to have sustained some injury by pressure, thus rendering them more vulnerable at these points to the action of the causes that produced the disease. By properly replacing the diseased parts with gold, the external surfaces of the fillings will be the only parts that come in contact with each other, and if of gold will not be liable to injury from the above-mentioned mechanical causes. The enamel around the fillings, if proper attention to cleanliness be observed, is not so liable to be acted on by chemical agents as the dentine which the cutting instrument would expose.

But teeth cannot always with impunity be separated by pressure; it can only be done with safety in certain cases. As a general rule, the writer is of the opinion that it ought not to be attempted after the thirtieth or fortieth year of age, though it may sometimes be done with safety at even a later period. The diseased action excited for the time in the sockets of the teeth does not so readily subside at a later age; and it has in some instances been known to result in the loosening and ultimate loss of the organs. In one case which came under the observation of the author the inflammation extended to the pulp, causing its disorganization and the consequent death of the tooth.

The pressure ought never to be too actively exerted; it should be gradual and constant. From three to five days are usually required for the separation of two teeth sufficiently for the removal of the decayed part and the introduction of a filling. After they have been separated in this way, they should be kept apart, without any increase of pressure, until the soreness in the cavities shall have subsided, before any further steps are taken in the operation. Cotton saturated with sandarach varnish, or white gutta-percha, or zinc filling materials, may be used to retain teeth after being separated with other substances, or by the rapid method. Only two teeth should be separated in the front part of the mouth in the same jaw at the same time. As soon as the cotton or tape, or other substance used to separate teeth, has afforded the desired space it should be removed, and the space retained for one or two days by cotton saturated with sandarach varnish, or white gutta-percha, or one of the zinc filling materials pressed between them, when the teeth may be well enough to permit of being operated on.

The pressure is usually made by introducing between the crowns of two teeth a thin wedge of soft wood, a piece of India-rubber, tape, a little raw cotton or ligatures, replacing the first-named substances every day or two with thicker pieces. While some prefer India-rubber to any other substance employed for the purpose, the object may be readily attained with other substances. Cotton or tape pressed firmly between the teeth and renewed daily, also gutta-percha, will in the course of a few days separate teeth, and with less soreness than India-rubber, to the use of which many object on account of the irritation it causes. Many operators prefer gradual pressure in separating teeth, but others, on account of economy of time, consider it better for the separation to be made at once, and not prolonged through several days. It is also urged that the patient suffers less and that there is also less danger to the teeth, in rapid separation than where this process is gradual. The degree of pressure and the method by which the separation is to be accomplished should, however, be determined by the susceptibility of the parts to inflammation. The operation of rapidly separating the teeth consists in the use of two wedges of fine-grained wood, either orange or boxwood. The first wedge is forced between the necks of the teeth, care being taken not to lacerate the gum, while the second wedge, which tapers more than the first, is inserted between the points of the teeth, the wedges being driven alternately by mallet force, until sufficient space is obtained, when the second wedge is removed. Very great care should be exercised in driving the second wedge between the points of the teeth, on account of the force exerted by it. This description applies to the front teeth, as it is not advisable to attempt the separation of the molar teeth in this manner.

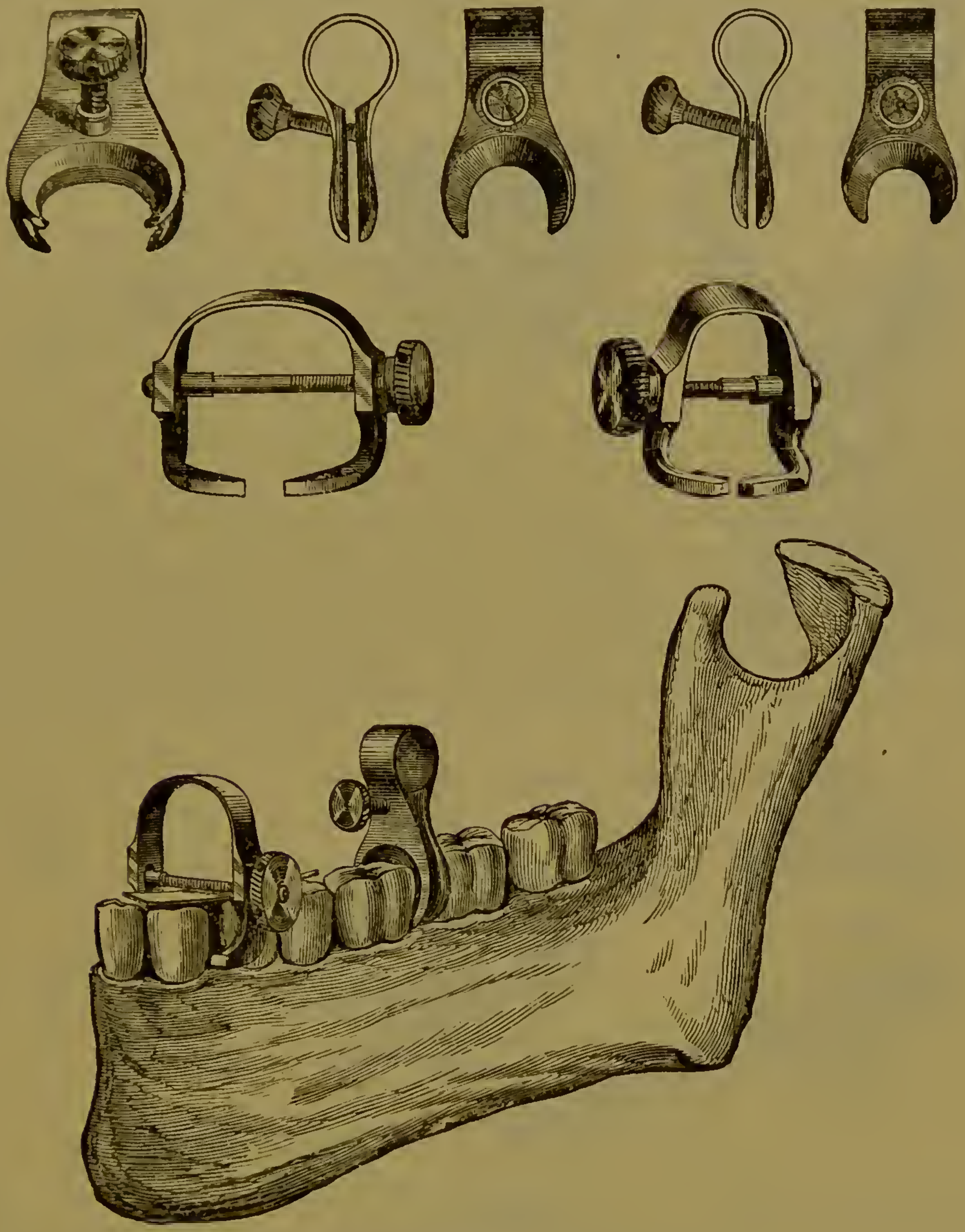


Fig. 360.

Fig. 360 represents a set of the Jarvis Separators, by means of which adjacent teeth can be forced apart without delay or appreciable pain to the patient. This separator consists of a piece of steel, nickel-plated, bent upon itself, having the two ends formed to fit the outer portions of the approximal surfaces of the two adjoining crowns. These jaws are forced apart by the action of the screw which passes through one and against the other. The compound forms consist of two wedges approaching or passing each other, and are applicable to the incisor teeth, the first forms being applicable to the bicuspid and molar teeth.

Figs. 361, 362, and 363 represent Dr. S. G. Perry's two-bar separators, which are operated by a wrench with a double end, one straight and the other bent at an angle, to give greater facility for turning the bars in different directions. The shape of these separators permits the teeth to which they are applied to be approached readily from either side. The arrows on the bars indicate the direction they are to be turned to spread the separator. Fig. 364, 365, and 366 represent Dr. W. A. Woodward's separators, the blades of which act independently, which is an advantage when the teeth are irregular.

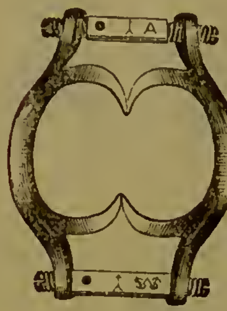


FIG. 361.

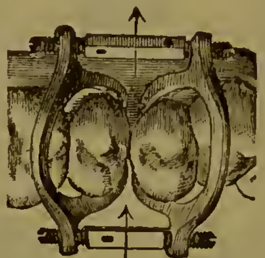


FIG. 362.

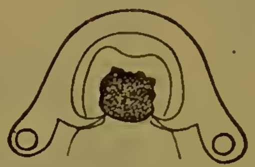


FIG 363.

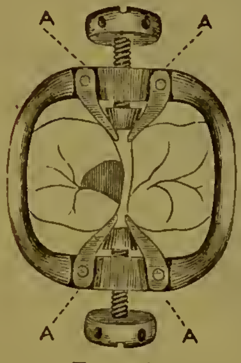


FIG. 364.

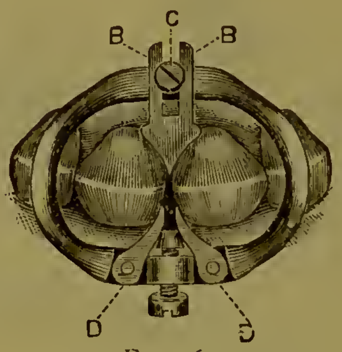


FIG. 365.

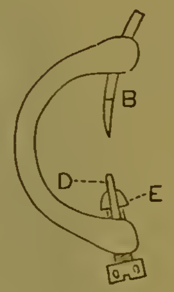


FIG. 366.

Fig. 367 represents Chase's Dental Wedge Forceps, by which wooden wedges can be forced between adjacent teeth for the purpose of separating them, and by the use of this appliance it is claimed that there is less danger of irritation and subsequent inflammation than by the method of driving a wedge with a hand-mallet.

Dr. Corydon Palmer recommends the following method of rapid wedging: A wedge made from a thin piece of wood or quill is first introduced between the teeth to protect the gum. Next to the first wedge, a square, tapering one, of orange or boxwood, is introduced at the gum in such a manner as not to interfere with the view of the wall of the cavity, and which is permitted to remain during the operation of filling, being driven to hold the space gained by a broad wedge introduced by hand pressure or mallet force between the cutting edges of the teeth, its point being directed toward the gum. The separation is gradually accomplished, in order to allow the tissues to accommodate themselves to the pressure to which they are subjected. It is recommended that the rapid process for separating teeth be restricted to cases where but little space is required, and where the structures are soft and spongy. Fig. 368 represents a wedge cutter for removing the projecting portions of the wooden wedges.

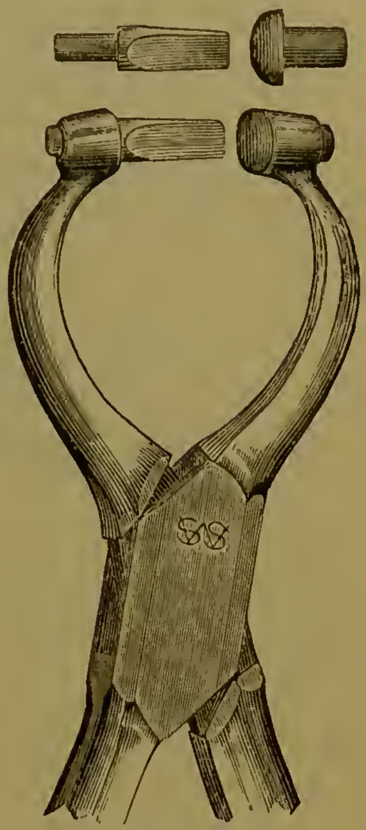


FIG. 367.

After separating teeth by rapid wedging, the wooden wedges should not be permitted to remain between the teeth, when more than one sitting is necessary to complete the operation of filling, but removed, and the space maintained by cotton saturated with sandarach varnish, or by gutta-percha, until the next sitting.

There is a difference of opinion among many prominent and skillful operators in regard to the permanent separation of the teeth, the advocates of contour fillings objecting to the removal of so much tooth-

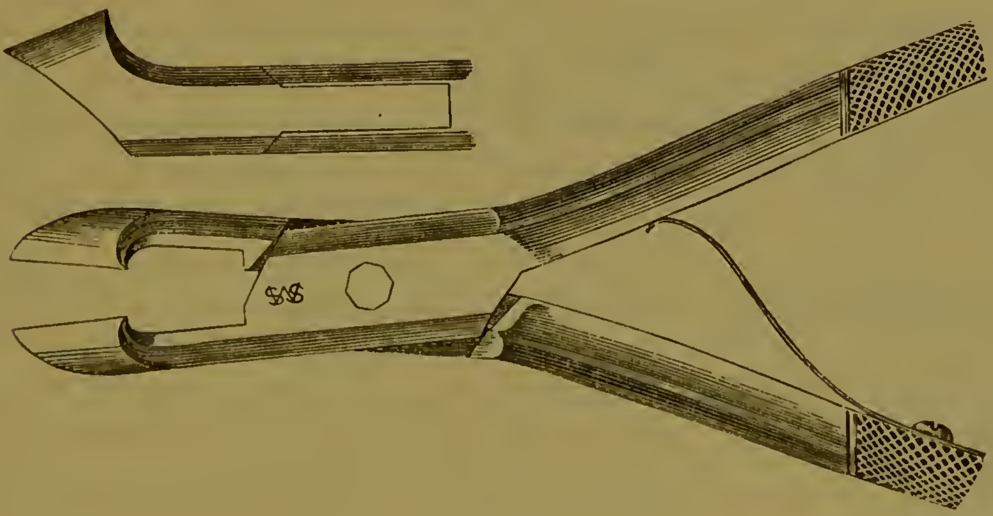


FIG. 368.

substance without substituting for it a non-destructible substance, such as gold, while the advocates of the permanent separation method contend that self-cleansing surfaces, properly prepared, are preferable to the labor, pain, time, expense, and general strain for both patient and operator in perfecting contour work.

Dr. T. F. Chupein, an advocate of the permanent separation of the teeth, describes his method as follows:—

"The mode of treating the upper incisors and cuspids is indicated by the following diagram, Fig. 369.

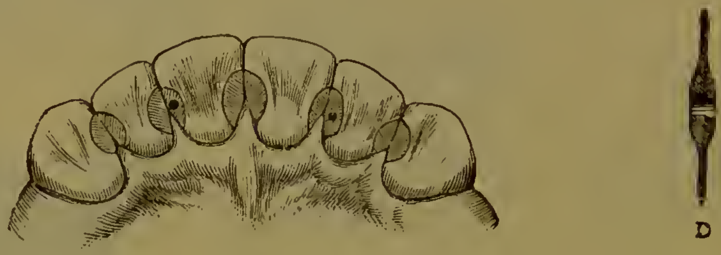


FIG. 369.

"It will be noticed that there are semilunar spaces cut from the palatal surfaces of each tooth. These spaces are cut for the removal of incipient decay, for its anticipation, as well as to obtain room to fill when decay is deep-seated. To make these spaces without mutilating the outer faces of the teeth, we proceed as follows: Two teeth are well wedged apart by the introduction of wooden wedges, floss cotton, or rubber, whichever seems best to the operator. When separated about the thirty-second of an inch or more, a thin disc is used on the dental engine. The Arthur disc, D, is about the proper size, and this is used on the palato-mesial and distal aspects of the teeth being operated on, and the cutting so shaped that the outer faces of the teeth are not encroached upon. After the enamel from these surfaces is removed, a curved file, (see Fig. 370), may be used to curve out the surface begun by the disc, or, what is still better, a small corundum point, mounted on the right-angle attachment of the dental engine, and applied between the two teeth to be operated on, the head of the patient being well thrown back, so that these surfaces may be

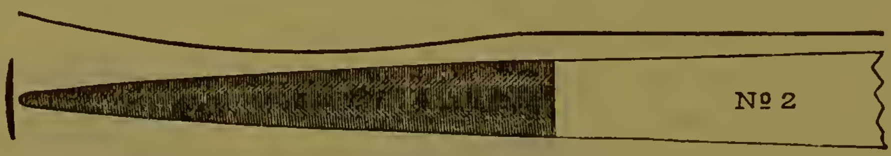


FIG. 370.

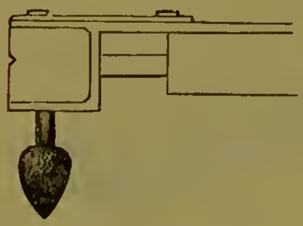


FIG. 371.

readily reached. Should either of the teeth thus separated need filling, the filling should be done at once, as more room is had now than if the teeth are permitted to fall back into their old places. When two are thus separated (and filled, if they need filling), two more are wedged apart and the spaces cut, as has been described."

Concerning the treatment of the bicuspids and molars, Dr. Chupein says: —

"These teeth are so concealed by the lips that even when pretty wide separations are made between them they present no revelation of their having been operated upon at all. To separate the molars and bicuspids we do not wedge them apart, as we recommend the incisors and bicuspids to be done (although it would be no detriment to do so), but we leave the teeth in the relation, one to the other, that we find them, and separate them, so as to leave a small point of contact near the gum margin. This point of contact, though minute, is sufficient to keep the surfaces that have been deprived of the enamel by the disc or file from again approaching each other, and also serves to protect the gum from being irritated by the impaction of food. Fig. 372 will illustrate this idea.

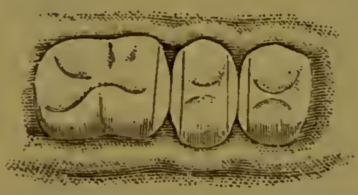


FIG. 372.

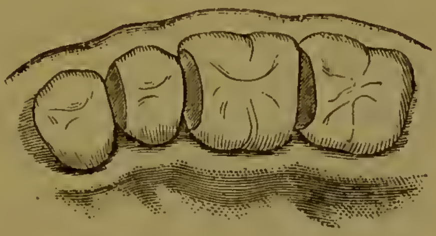


FIG. 373.

"It will be seen that the filed surfaces are entirely kept apart, and that though the tooth may change its position or turn in its socket (which is not likely) the cut surfaces would be still kept from close proximity. It also permits a free space, which is readily kept clean by simply rinsing the mouth. We fear that it is the careless manner in which this operation has been performed that has brought it into disrepute, and which, from this carelessness, has made many who tried the system abandon it as being ineffectual, when the fault lay more in the manner of its performance than in the integrity of the operation. Particular stress must be laid on the *non-removal* of this point of contact, otherwise the operation becomes ineffective. Indeed, if it is removed we consider that the operation would be worse than if nothing at all had been done. To make it entirely effective it should be done in anticipation of decay or when decay is in its first stages—when it has not, or scarcely has, pierced the enamel. If attempted later the very point of contact we wish to preserve will be encroached on by decay or completely destroyed by it. If in anticipation of decay, the cutting need be done only from one tooth, and that from the mesial surface of the furthest back tooth. Fig. 373 will illustrate this.

"We would recommend that after the teeth are separated a waxed thread be passed through the separations down to the gum, and that this should pass the point of contact *easily* and with a *snap*, to indicate that the teeth are just held apart, but yet touch sufficiently that their relation one to the other should not have been changed. The thread or silk thus used should not be frayed. This would indicate roughened edges of enamel or too close contact. If the former, it should be polished or cut smooth; if the latter, the point of contact should be lessened so that the string will pass through readily and with a snap. We recommend, too, that the rubber dam be applied on these teeth after these separations are made. It will often *appear* that all decay has been removed. This deception is caused by the gloss left on the cut surfaces by the saliva, but when the dam is applied and the surfaces dried and critically examined, we can know for certain if all the disorganized tissue has been removed or not.

"We proceed to make these separations by arming the dental engine with a disc like that represented at Fig. 369 D. We cut the teeth through from their buccal to their palatal aspect, if in the upper, and from their buccal to their lingual aspect if in the lower jaw. We stop from time to time as we proceed, to see if we have not gone too far. When nearly down to the point of contact, near the gum, we stop with the engine and finish with a file having a round edge, like Fig. 374; or, in case of molar teeth, with a file like Fig. 375. When finished, the buccal aspects of the teeth have the appearance represented by Fig. 376, while the teeth viewed from their masticating surfaces are represented by Fig. 377.

"Should it be found necessary to fill the teeth thus separated, an easy approach to the cavity is had, and the fillings as well as the filed surfaces can be left highly polished.

"The class of teeth shown at Fig. 378 are such as we recommend to be treated as we have described, for they present broad surfaces of contact on their buccal, masticating, and palatal aspects, and are thus rendered more prone to decay from the ready lodgment of particles of food between them.

"The other class of teeth, represented by Fig. 379, rarely decay, because, as will be seen, they touch only by minute points of contact, and are thus not liable to decay. We do not recommend teeth of this form to be separated. If they decay they should be wedged apart and filled, and allowed to fall back in their old position. Decay in teeth of this class will generally be found above the point of contact,

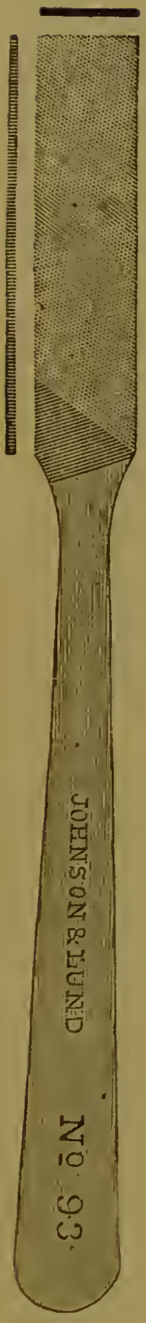


FIG. 374.

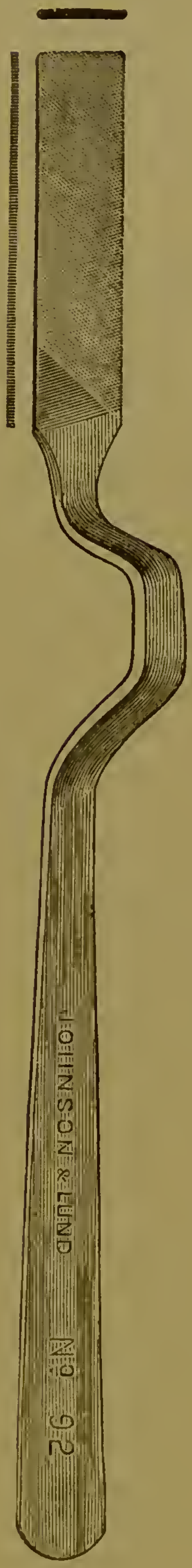


FIG. 375.

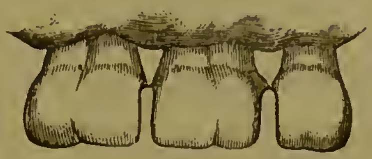


FIG. 376.

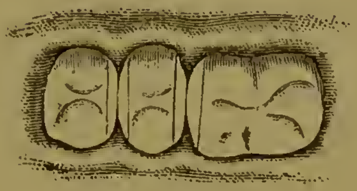


FIG. 377.

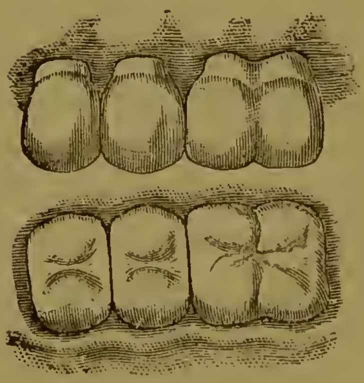


FIG. 378.

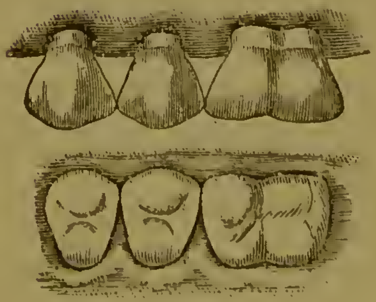


FIG. 379.

toward the gum. Should permanent separation be attempted with teeth of this class it might prove ruinous, or if effective the teeth must, from their shape, be considerably mutilated and cut away, to prevent the cut surfaces from again falling in close apposition. Judgment, therefore, must be used in the separation of the teeth, although, as we have said, the operation is comparatively simple.

"But whether the teeth be separated with cutting instruments or by pressure, the space should be sufficiently wide to enable the dentist to operate with ease, otherwise it will be impossible to remove the caries and fill the teeth in a proper manner."

TREATMENT OF DEEP-SEATED CARIES.

Filling teeth is one of the most difficult operations the dentist is called upon to perform; it often baffles the skill of operators who have been in practice many years. It is advisable only under certain circumstances, and when the operation is performed without due regard to these it must be productive of injury rather than benefit. It is the only certain remedy that can be applied for arresting the progress of deep-seated caries; but to be effective it must be executed in the most thorough and perfect manner. The preservation of a tooth may be regarded as comparatively certain when well filled, and with a suitable material, if it be afterward kept constantly clean. At any rate, it is not likely ever again to be attacked by caries in the same place.

On this highly important operation Dr. E. Parmly thus remarks: "If preservation is as good as a cure, this is as good as both; for the operation of filling, when thoroughly performed, is both preservation and cure. And yet it must never be forgotten that this assertion is true only in those instances in which the operation is well and properly done; and perhaps it is imperfectly and improperly performed more frequently than any other operation on the teeth.

"There are reasons for this fact, into which every ambitious and honorable practitioner will carefully inquire. Although the books are explicit on this point, I deem it sufficiently important to deserve a few additional remarks. The following considerations are essential, and, therefore, indispensable to success in this department of practice. *Firstly.* The instruments used must be of the proper construction and variety. *Secondly.* The material employed must be properly prepared as well as properly introduced. *Thirdly.* The cavity which receives the filling must be so shaped as to retain it in such a manner as to exclude not only solids, but all fluids, and even the atmosphere itself. *Fourthly.* The surface of the filling must be left in such condition as to place it beyond the reach of injury from food and other mechanical agents with which it necessarily comes in contact. *Fifthly.* The tooth thus filled should be free from pain and every known cause of internal inflammation."

It is important that the operation be performed before the disease has reached the pulp-cavity; after this, the permanent preservation of the tooth may be regarded as more or less questionable. Still, under favorable circumstances the author believes it may, in the majority of cases, be performed with success. But, as the propriety and manner of filling a tooth after the pulp has become exposed will hereafter come up for special consideration, as well, also, as the operation of filling the pulp-cavity after the destruction of the pulp, it will not be necessary to enlarge upon these subjects at this time.

MATERIALS EMPLOYED FOR FILLING TEETH.—Among the articles which have been employed for filling teeth are gold, platina, silver, tin, lead; fusible alloys of tin, lead, bismuth, and cadmium; amalgams, gutta-percha, oxychlorid of zinc, oxyphosphate of zinc, and various preparations of the gum resins. Of these no single one can be said to unite all the requirements of a perfect material for filling, which may be enumerated: 1. Resistance to the mechanical action of mastication. 2. Resistance to the chemical action of the mouth. 3. Facility of introduction and consolidation. 4. Harmony of color. 5. Absence of all galvanic, chemical, or vital action upon the teeth or the general system. 6. Absence of all heat-conducting property. 7. Absence of shrinkage.

Gold Foil.—To the use of this material, when properly prepared, there is the least possible objection, perfectly answering the first, second, fifth, and seventh requirements, to a great extent the third, if in skillful hands, but deficient in the fourth and sixth. No better material is wanted for the operation. A tooth may be so filled with it as to secure, in almost every case, its permanent preservation. It should, however, be perfectly pure, be beaten into thin leaves, and well annealed by the manufacturer before it is used. When prepared in this manner, it may be pressed into all the inequalities of the cavity, and rendered so firm and solid as to be impermeable to the fluids of the mouth.

Although there may be no difference in the purity of the gold and the thickness of the leaves, yet a marked difference will be found to exist in the malleability and toughness of the foil of different beaters.

The art of preparing gold for filling teeth is an exceedingly nice and difficult one, and is believed to have attained greater perfection in the United States than in any other country; at least, this fact is so generally admitted that many of the most eminent European practitioners procure nearly all they use from America. (See process of manufacture in "Harris' Med. and Dent. Dictionary.")

The principal preparations of gold used for filling teeth are the non-cohesive, the cohesive, and the sponge or crystal gold.

Non-cohesive or Soft Gold Foil.—This is a preparation of leaf gold which does not possess the property of cohesion to such a degree that the leaves can be firmly united on being pressed together with moderate force, and is introduced on the wedging principle, the cavity for its reception being made of such a form or shape as will retain the mass after it has been properly introduced and consolidated.

Non-cohesive gold foil is employed in different forms, such as the rope, the tape or ribbon, the cylinder, the pellet, and the mat or block.

The thickness of the leaves is determined by the number of grains each contains, and is designated by numbers on the books between the leaves of which they are placed after having been properly annealed. These numbers range from 3 to 240. A book containing a quarter of an ounce of No. 4 will have thirty leaves in it. Some dentists use foil varying in numbers from 4 up to 20, and even, of late, to 120, while others confine themselves to a single number. If but one number of the non-cohesive be used, 5 will perhaps be found better than any other. The author has used Nos. 4, 5, 6, 8, 10, and 15, but he prefers 4 and 5, and is decidedly of opinion that, in a large majority of cases, a better filling can be made with the first two numbers than any of the others. There may be cases in which higher numbers can be more advantageously employed; as, for instance, in cavities which are *very* large, and where the operation of filling has extended beyond the walls of the cavity, owing to the difficulty of securing a perfect adaptation.

Cohesive Gold Foil.—This is a preparation of leaf gold which possesses the property of cohesion to such a degree that the leaves readily and firmly unite on being pressed together with moderate force.

Although one or two others claim priority in the discovery of the advantages now derived from the use of cohesive gold foil, yet the credit is certainly due to Dr. Robert Arthur, as he was not only the first to demonstrate the applicability of this form of gold in filling teeth, but in a series of well-written articles* he overcame the objections which were at first urged against it, and proved that its great cohesive property rendered it a valuable adjunct in the preservation of the teeth. This form of foil is so cohesive that any number of pieces may be welded one to another; thus a part, or even the whole of the crown of a tooth may be built up with it. The same property may to a limited extent also be imparted to foil manufactured in the ordinary way of reannealing. This property is peculiarly valuable in many cases where it becomes necessary to build up a large portion of the crown of a tooth; but when it is used, instruments having serrated points are required, like those employed in the use of crystal or sponge gold.

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* "A Treatise on the Use of Adhesive Gold Foil," 1857.

Crystal or Sponge Gold has been employed by dentists for filling teeth for a number of years. The author has used it in a number of cases with very satisfactory results. Since the publication of the fifth edition of this work, the properties of crystal or sponge gold have been more thoroughly and extensively tested, and the result has fully confirmed the favorable opinion entertained by us with regard to its value. The author was acquainted with several of the most skillful operators in the United States who used it almost exclusively in their practice for several years, and saw fillings made by some of these gentlemen which, for beauty and solidity, he does not think could be surpassed. This form of gold has a spongy texture, being composed of crystals, and widely differs from foil or leaf gold. The crystals possess the property, when pressed firmly against each other, of welding and becoming as solid and almost as incapable of disintegration or crumbling as a piece of bullion or coin. This property enables a skillful manipulator to supply almost any loss which a tooth may have sustained, even to the building up of an entire crown. Still, it will never supersede the use of cohesive and non-cohesive gold foils, as there are many cases in which leaf gold can be used more advantageously and with more facility. Nor will the employment of it, in the opinion of the author, ever become universal, for the reason that more care and skill are required to make a good filling with it than with leaf gold, especially when the cavity in the tooth is difficult of access. Filling with crystal gold is more tedious than the same operation with ordinary foil.

Experiments have been made with *silver*, *platinum*, and *aluminium*, but with unsatisfactory results. They are less malleable than gold, and therefore cannot be made so thin; at the same time they have not the softness of tin, hence they work harshly under the plugger. An additional objection to silver is its liability to undergo chemical change, being in this respect greatly inferior to pure tin. Platinum, while it possesses indestructibility, in this respect being even superior to gold, is deficient in other properties as a filling material, as it cannot be welded with facility, is difficult to manipulate in the form of foil on account of its stiffness and harshness, and hence cannot be adapted and condensed in such form to the surface of a cavity. A form of platinum known as *platinum sponge* has been employed with greater facility than platinum in leaf form, but it requires skillful manipulation, and its cohesive property is readily destroyed by the slightest degree of moisture. Platinum has also been used in the form of foil coated with a considerable thickness of pure gold, and it is claimed that by such a combination a denser filling can be made, and also one conforming to the color of the tooth in which it is placed. The peculiarity of aluminium, in this relation, is the impossibility of welding its leaves by pressure; even under the gold-beater's hammer it forms loose scales, which no annealing can make adherent.

Tin Foil.—This, when chemically pure and properly prepared, is less objectionable for filling teeth than most of the articles hereafter enumerated. Under favorable circumstances, if skillfully introduced, it will prevent the recurrence of caries. The greatest objection, perhaps, to the use of tin foil as a filling material is its softness and consequent inability to withstand the friction of mastication for many years. When used in cavities not so exposed it answers a good purpose as a filling material, as it is unalterable by reagents. Being an inferior conductor of heat it is tolerated in sensitive teeth in cases where a better conductor, such as gold, would not be. It is also regarded as valuable in soft teeth, and some regard it as possessing advantages over gold for filling in such teeth, and also in the temporary teeth, being easy of introduction and in accord with the tooth-structure. On account of the qualities referred to, tin foil is sometimes employed for lining cavities to be filled with gold. It is prepared as a filling material in the form of foil, the leaves varying in thickness from No. 4 to No. 20. The numbers from 4 to 10 are mostly used, and it is manipulated in the same manner as non-cohesive gold foil.

Lead is far more objectionable than tin, as it is more easily decomposed by the secretions of the mouth; its introduction into the stomach might be productive of serious injury to the general health of the patient. But, happily, the article is now seldom, if ever, used.

Amalgam, formerly known by the name of *mineral cement,* or *lithodeon,* is usually composed of about equal parts, by weight, of pure tin, silver, and varying proportions of zinc and platinum—and sometimes gold and copper—the zinc, about one to three per cent., constituting a most important element in controlling shrinkage and preventing oxidation. The gold is not especially valuable, and when used in an amalgam from one to four per cent. is sufficient. These metals are melted in a crucible and poured into ingots, which are then cut up with a file into filings. These filings are mixed, after the cavity in the tooth is prepared for the filling, with about thirty-three and one-third per cent. of distilled mercury, and incorporated to the consistency of a thick paste. The mass is then thoroughly washed with alcohol, to which is added a few drops of a strong solution of chloride of zinc. The excess of mercury is then removed by twisting the mass in a piece of chamois skin or strong muslin. It is also recommended to press the mass quite thin, after it is removed from the chamois skin, with a strong pair of flat pliers, in order to remove still more of the mercury. Caution should, however, be used to avoid pressing out too much mercury. The mass, when introduced, should be about the consistency of ordinary putty. The cavity should be prepared with as much care as for a gold filling, and moisture prevented from coming in contact with it. When the cavity approaches near to the pulp, some non-conducting substance, as Hill's Stopping, should be applied between the amalgam and the bottom of the cavity. After the filling has become sufficiently hard, its surface should be carefully finished by filing and burnishing.

Dr. Bonwill gives the following directions for working amalgam composed of silver, tin, and gold; from five to seven per cent. of the latter he considers sufficient:—

"As soon as the first piece of alloy is inserted, a wad of bibulous paper (Japanese) as large as the cavity is placed thereon, and an oval-pointed steel instrument is pressed upon it with great force, to crowd out the superabundant mercury. Go on adding alloy and more paper until the cavities are crowded full from cuspid to molar, leaving no intervening space. Direct pressure is not as efficacious as rubbing the amalgam in with a burnisher over the paper, which drives the mercury out at all points. No rough-faced instrument should be used; smooth burnishers and oval-faced only, on the same principle as in rubbing in gold by the action of the mechanical mallet. When you have reached nearly the proper fullness, use the flatter burnishers entirely, to not only add the alloy, but to be sure that the mercury is carried to the edges. To do this you must not lose a moment; and the alloy should not have too much gold in it, or you cannot undertake so much at one sitting."

Describing the operation of filling with amalgam the superior cuspid decayed on its distal surface, with the first and second bicuspids on the anterior distal, and grinding surfaces gone so far as to leave nothing standing but the buccal and palatal walls, and to this add the first molar with its anterior wall, crown, and distal surfaces as seriously involved, the same writer continues:—

"By the time you have gotten all the cavities full, you must commence at once to divide between each and contour.

"It will be found that when the opposite teeth are made to antagonize with it, great care must be used to keep from dislodging any portion of this large mass; therefore, before the division on the approximal surfaces is made, see that the articulation is absolutely correct. Then with a broach with small point turned, scratch away all the cervix until the tool reaches from both buccal and palatal surfaces, and the divisions are clear to nearly the grinding surface. Now, with a very thin knife or saw you can carefully divide the fillings, to make each tooth distinct. In this proceeding great care must be exerted or the contour will be broken. When this has been done, shape with proper instruments, leaving all the grinding surface in contact as broadly as possible, so that when the teeth go back again to their positions from which the gutta-percha had moved them, the food cannot wedge down between them. Where cavities are obscure on approximal surfaces, get the alloy as nearly in place as you can, and a wad of paper will be sure to force it down. Besides those cases with more or less walls for support, in those where much of the cusps of either wall is gone the alloy can be added and compressed easily and surely. Entire or partial crowns can be secured in a few minutes. Be sure that the alloy is not allowed to remain projecting over the free margin of the contour before the patient leaves. Then but little dressing of the contour is necessary when the operations are filed and finished.''

FIG. 380.

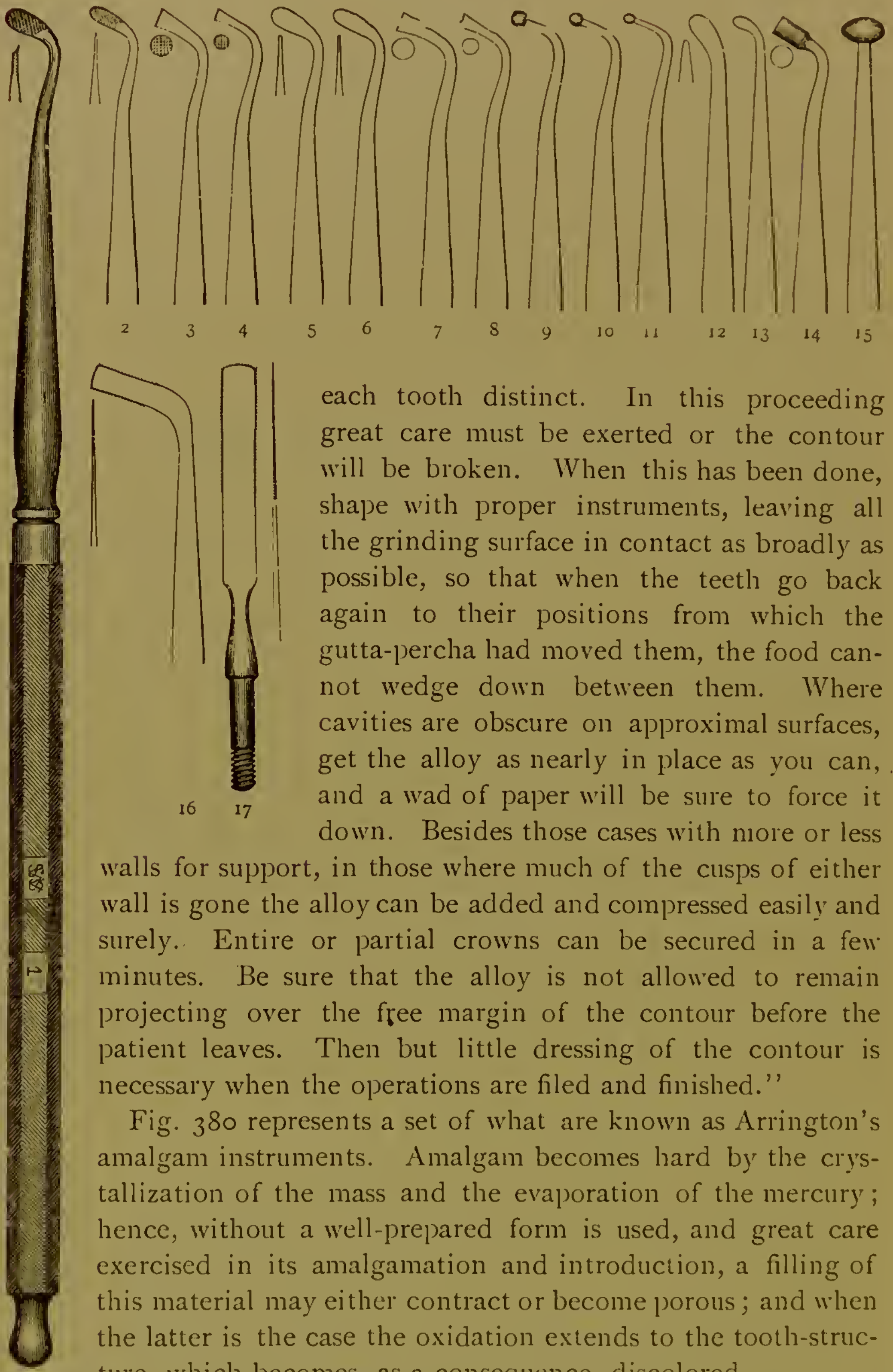

Fig. 380 represents a set of what are known as Arrington's amalgam instruments. Amalgam becomes hard by the crystallization of the mass and the evaporation of the mercury; hence, without a well-prepared form is used, and great care exercised in its amalgamation and introduction, a filling of this material may either contract or become porous; and when the latter is the case the oxidation extends to the tooth-structure, which becomes, as a consequence, discolored.

Amalgams, unlike the plastic gutta-percha and zinc preparations, do not adhere to the walls of the tooth-cavity; hence, in their use it is necessary that attention should be paid to the form of cavity into which they are to be introduced; and as they are often employed for filling cavities of a shallow form, and with frail walls, under-cuts and dovetails are required for the retention of such fillings. From the tendency of the amalgams of mercury to assume a spheroidal shape and separate from the margins of a cavity, sharp angles and pits are objectionable. The addition of palladium to an amalgam may prevent such shrinkage, but adds to the discoloration, and the rapidity of its setting is such as to evolve a sufficient amount of gas to cause an explosion with emission of light. Such an accident may be avoided by gradually adding the palladium powder to the compound and using very small pieces for introduction, and their rapid insertion, each piece being well compounded as it is added to the mass. It is claimed that while the surface of a palladium amalgam changes to a black color, it does not stain the tooth-structure, and that it is the most durable of the amalgams. An excess of silver will also cause an amalgam to blacken and stain the tooth-structure. Silver and copper control the change in form, as the solid particles of copper which remain have an amalgamated surface only, which prevents the change in form common to a homogeneous mass. Platinum imparts toughness and edge-strength to an amalgam. Gold makes an amalgam composed of tin, silver, and mercury unclean, although an amalgam of pure gold and mercury alone is white and clean, but is not adapted for a filling material.

A better class of amalgams now in use appears to change bulk to a less degree and to preserve their light, silvery color much better than the older forms; hence, the former objections to this filling material appear to have, in a great measure, been overcome. The ease with which amalgam fillings can be introduced no doubt often leads to carelessness in the manipulation of this material, but it should be remembered that to obtain the best results from it the cavity in which it is placed should be as carefully prepared as for a gold filling, and also that perfect dryness is essential to its adaptation and durability.

There exist some differences of opinion concerning the necessity for washing amalgam, prior to its introduction, with alcohol and other fluids, some contending that by so doing it is impossible to remove all the moisture in time for its insertion. Sufficient mercury should be allowed to remain in the mass as will permit of its being manipulated without crumbling, and when it is inserted over a sensitive surface or in proximity to the pulp of a tooth, some intervening substance, such as Hill's Stopping or oxyphosphate of zinc, should be placed between the sensitive surface and the filling.

It is claimed that continuous pressure with the burnisher upon the surface of an amalgam filling during its setting will prevent its tendency to separate from the walls of the cavity, and insure better results from its use. It is also very necessary that the margins of amalgam fillings should be well defined, as, owing to its brittle nature, thin, overhanging portions are liable to break away, leaving imperfections which may soon prove injurious to the filling. After an amalgam filling has become hard (and during this hardening process the patient should be warned against masticating upon it) the surface should be as carefully prepared and polished as that of gold filling.

The objections, therefore, urged against amalgam are, that it oxidizes and blackens; that the tooth-structure with which it remains in contact becomes discolored; that it contracts in hardening, allowing the secretions to make their way around the filling. Of late years it has been urged that it is incompatible with tooth-structure, and that the mercury might act injuriously on the system. These objections are characteristic of most of the amalgams now on the market, although in a few notable exceptions they have been almost entirely overcome; but there is no good reason why amalgam should be incompatible with tooth-structure, or that the small amount of mercury imprisoned in this alloyed mass should possibly produce any mercurial effects. There is good reason, therefore, for believing it to be, in these respects, perfectly inert. The use of amalgam is *contraindicated* in all teeth which can be filled with gold—in the front teeth on account of its color, and in pulp-cavities on account of the difficulty of introduction into small canals. Various opinions are held as to the indications for the use of amalgam. In our own opinion it is one of the most valuable materials for some operations, as, for instance, in cavities so difficult of access as to render the introduction of a perfect gold filling doubtful, and where the operation would be long, tedious, and difficult to both patient and operator, were gold used. Amalgam is also employed by some for filling roots, on account of the ease and facility with which it can be carried to the end of the root-canal.

Fig. 381 represents some forms of amalgam Carriers and Fillers.

Several of these instruments are constructed with fixed points, covered by a tube, which projects to form a cup for the amalgam, and recedes so that the points work through as Pluggers to force it into the cavity, one being half-curve, another double-end, giving two angles, and another straight. One has a fixed tube with spring plunger to force in the amalgam. A Loadstone Carrier and Plugger has a double end, one point of which is so prepared as to attract amalgam, which will adhere to it while being conveyed to the cavity in the tooth; the reverse end is made as a Filler.

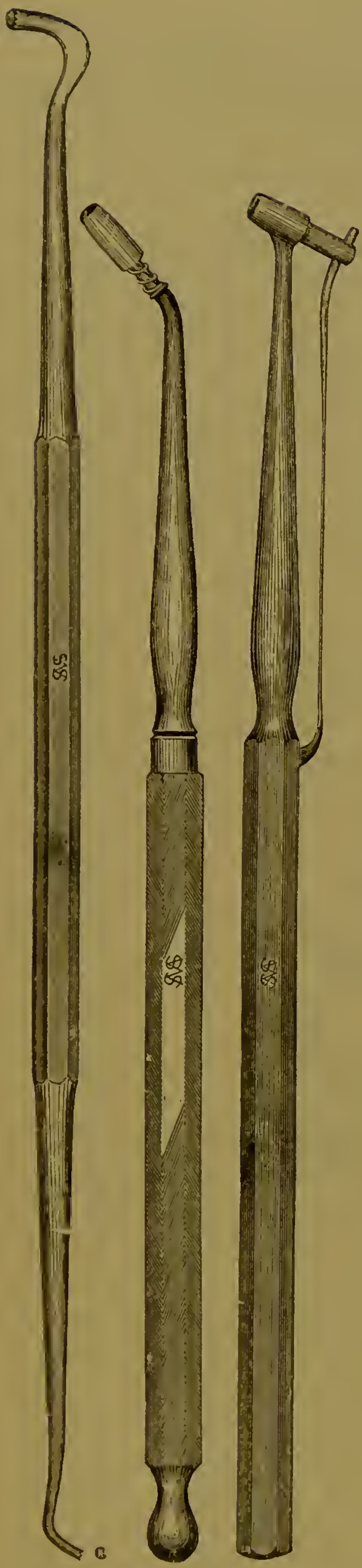

FIG. 381.

Fig. 382 represents a Mercury Holder for convenient preparation of amalgam.

Fig. 383 represents a set of Weston's Amalgam Pluggers.

Gutta-percha and Hill's Stopping.—Gutta-percha is an excellent material for temporary fillings. It may be made harder, whiter, and less contractile by incorporating with it some very fine powder of feldspar, silex, lime, or magnesia. A very excellent preparation known as *Hill's Stopping* is made by mixing gutta-percha with as much of the following powder as it will hold without becoming brittle; quicklime, two parts, very fine quartz and feldspar, one part each. Prepared gutta-percha and Hill's Stopping are introduced in small pieces by first warming on a porcelain or metal-slab, over an alcohol lamp, until they become plastic enough to be readily pressed into the cavity and to adhere to its walls. As soon as the cavity is filled, an instrument having a condensing point large enough to cover the entire surface of the filling should be applied and kept in position until the mass has become cool.

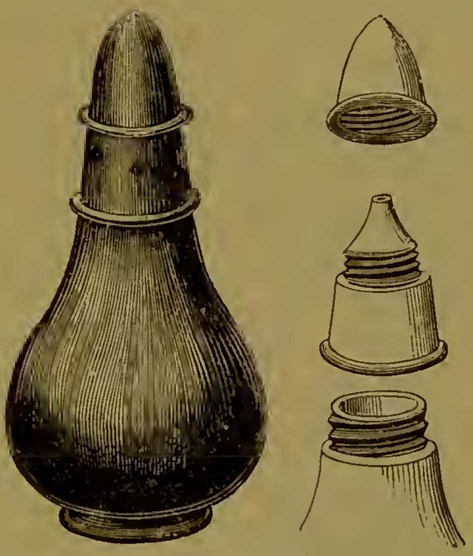

FIG. 382.

Fig. 384 represents Dr. Howe's Thermoscopic heater for scientifically softening gutta-percha, which is described as follows:—

"The Heater (illustrated natural size) is made of steatite, which absorbs heat slowly and retains it a long while. A non-conducting handle of wood allows the Heater to be held over the flame, as shown. In a small recess a quantity of metal, A, fusible at 212° F., is placed. When this melts, the Heater may be set on the bracket-table, and gutta-percha pellets, 1, 1, will be found to be safely and suitably softened for use. Low-heat pellets, as 2, 3, or 4, are placed at various distances from A, according to their softening points, to insure their being heated to exactly suitable temperatures. For high-heated pellets, A is melted, poured out, and the 230° F. button B substituted. The Thermoscopic Heater thus enables the dentist to heat gutta-percha of whatever grade to its proper softening point with the scientific certainty of uniformly producing suitable plasticity without danger of injuring the sensitive material, which is so frequently burned, smoked, or otherwise impaired by the crude methods in common use, meeting every need."

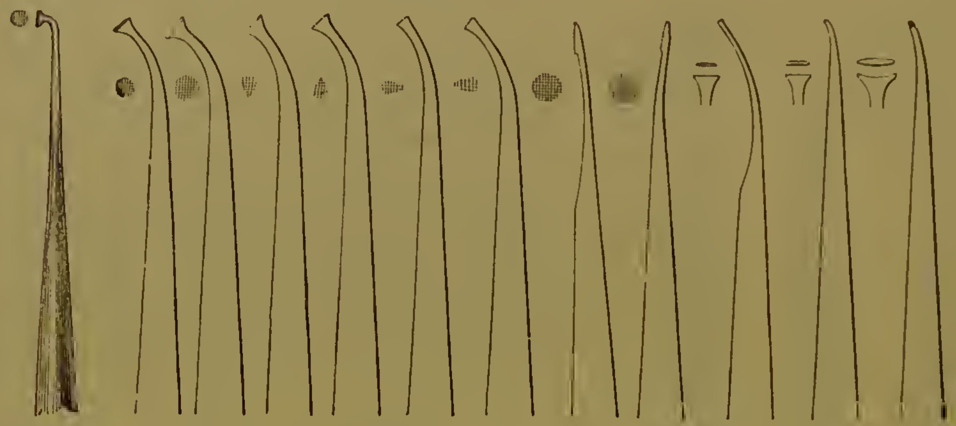
FIG. 383.

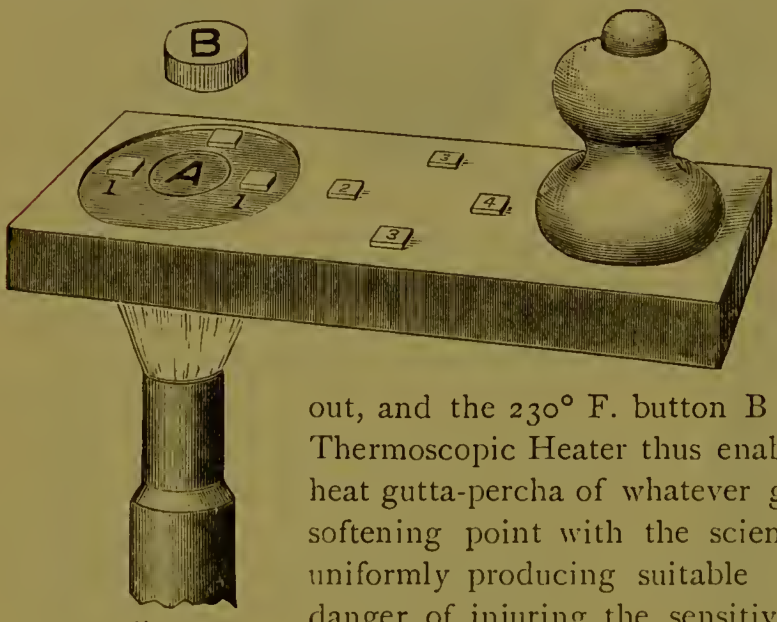

FIG. 384.

The preparations of gutta-percha now used for filling materials possess different grades of plasticity, so that a filling may be commenced with one that softens at a low temperature, and finished with another which requires more heat to render it plastic, and hence becomes harder. For cavities situated on the approximal surfaces of the teeth and extending below the margin of the gum, gutta-percha preparations appear to answer a good purpose in resisting the dissolving action of the acid from the inflamed gum. When the gutta-percha preparation is made plastic enough to adhere to the walls of a cavity, by passing it through the flame of a spirit-lamp, care is required that it should be evenly heated and not burnt. By using the lower grade over sensitive portions of a cavity less pain is experienced from the heat, and after the cavity is filled with the higher-grade material the surplus can be removed with thin steel or platinum spatulas heated to the required degree, and the surface made smooth by passing over it a burnisher. Chloroform applied to the surface of a gutta percha filling will give a smooth finish, but may render such a surface less durable on account of its dissolving action.

Fig. 385 represents a set of Dr. W. A. Bronson's gutta-percha instruments.

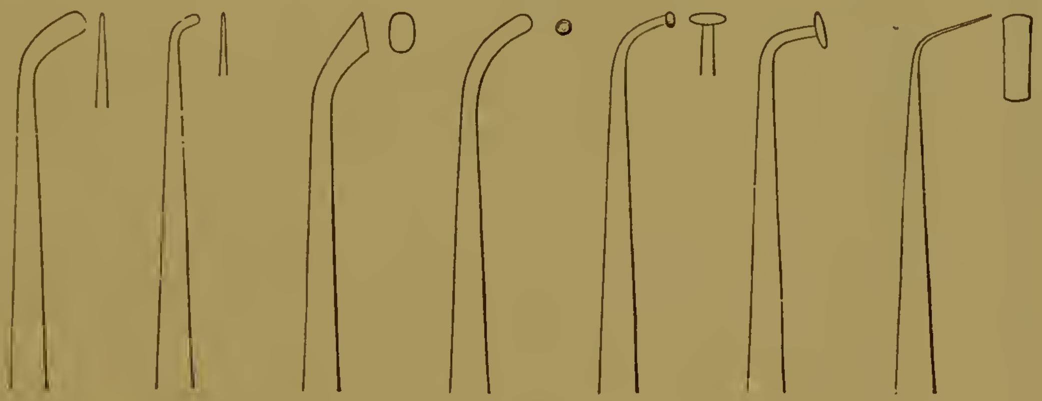

FIG. 385.

Zinc Preparations.—A mixture of chlorid of zinc and oxid of zinc has been much used under the various names of *oxychlorid of zinc*, *os-artificial*, *osteo-dentine*, *osteo-plastic*, mineral paste, etc. Quackery has seized it with eagerness, and plastered up many teeth with a mortar even more conveniently used than amalgam. Although in some few cases it may resist the action of the secretions of the mouth, it will not answer for a permanent filling. The friction of mastication soon destroys it, and in approximal cavities it frequently crumbles away in a few weeks or months. Still, as a *temporary* filling, it may, if employed with caution and judgment, be found useful, and for certain cases very valuable. It has been used with success for filling the pulp-cavities of the teeth. It has also been applied to partially exposed nerves, and in some favorable cases successfully, but its use for such a purpose is very uncertain, as the escharotic action of the zinc chlorid may produce death of the pulp. In the combination of the oxychlorid ingredients the oxid of zinc is usually mixed with some siliceous substance, to increase the hardness, and the chlorid of zinc is diluted with water. When the powder and liquid are combined a cement results, which forms hydrated oxychlorid of zinc by the taking up of some of the water as a base. Some prefer mixing the oxychlorid in the form of a thin paste, and after adapting it carefully to the bottom and sides of the cavity, or over a sensitive surface, to complete the operation with a paste of thicker consistency. A warm burnisher will hasten the setting of the oxychlorid and apparently increase its hardness. The application of talc (soapstone) in the form of a properly-shaped point, which may be heated, or in the form of powder, appears to improve the surface of such a filling by rendering it less permeable to moisture. On account of the oxychlorid preparation being acted on by weak acid and even alkaline solutions, it cannot be depended upon for a permanent filling material, and will frequently dissolve away in a few weeks or months, especially if introduced near to or beneath the margin of the gum. It often answers a good purpose when applied to sensitive dentine, but, like the chlorid of zinc, one of its ingredients, its application causes considerable pain for a short time. It has also been employed for bleaching discolored dentine, and as an interposing substance between a thin wall of cavity and darker, but more durable, filling material, such as amalgam.

Of late years various preparations, known as *oxyphosphates of zinc*, have been introduced, composed of the basic oxid of zinc and glacial phosphoric acid. One of the zinc preparations is composed of the nitrate of zinc and phosphoric acid. The oxyphosphate preparations are preferable to the oxychlorids on account of their being less irritant to the pulp and more durable, especially when placed about the necks of the teeth. They have also the advantage over the oxychlorids of greater hardness, but it should be remembered that all of the zinc preparations are liable to be dissolved by the fluids of the mouth, and hence are not so reliable for temporary fillings as gutta-percha, especially the form known as Hill's Stopping, particularly where such fillings extend beneath the margin of the gum to the cementum.

The oxyphosphates mix less readily than the oxychlorids, and require more care in the combination of the powder and liquid. If mixed too thin, a sticky, unmanageable mass results, and if too thick the mass will crumble in pieces; it is therefore recommended to so prepare it that it may be rolled between the thumb and finger without adhering to them, or, on the other hand, crumbling to pieces. On account of the oxyphosphate setting very rapidly, the cavity should be ready to receive it before it is mixed, by being free and protected from moisture by the application of the rubber-dam.

Like the oxychlorid, it is necessary that the surface of a filling of this material should be protected from moisture for some minutes after its introduction, and the same substances may be used to coat over the surface, as in the case of the oxychlorid. Unlike the oxychlorid, however, a warm instrument cannot be employed to hasten its setting. A number of forms of these cements are in use under the names of those originating them. One form, known as Poulson's, is the pyrophosphate of zinc, the pyrophosphoric acid being in crystals, which require to be melted in a platinum or porcelain spoon held over a spirit lamp, care being taken that ebullition does not occur. When reduced by heat to the consistency of glycerin, it is dropped upon a warm porcelain slab, and is ready for introduction into the cavity. Exposure of this preparation to the air causes its deterioration, hence it should be kept in hermetically sealed vessels. Some of these plastic zinc preparations appear to be much less soluble in some mouths than in others, and considerable importance is attached to the manner in which they are mixed and inserted into the cavity.

In using any of these preparations the cavity is prepared as usual; then a small quantity of the liquid (either the chlorid of zinc or the phosphoric acid) is dropped upon a piece of glass or porcelain, and enough of the powder (oxid of zinc) added to make a paste so thick that the surface will not appear watery. The cavity having been perfectly dried and protected from saliva, the material is quickly introduced, after which it is kept free from moisture for ten or twenty minutes. When sufficiently hard, the surface is finished by scraping and polishing. The longer the surface is kept dry, the harder these materials become. Coating the surface with sandarach varnish (or gutta-percha dissolved in chloroform, or melted wax) will afford protection for some time.

In all cases where these preparations are introduced near a pulp, or as a capping over exposed pulps, the cavity should always be previously wiped out with a solution of gutta-percha and chloroform, to prevent the escharotic and irritant effect.

Fig. 386 represents platinum points for oxychlorid and oxyphosphate filling.

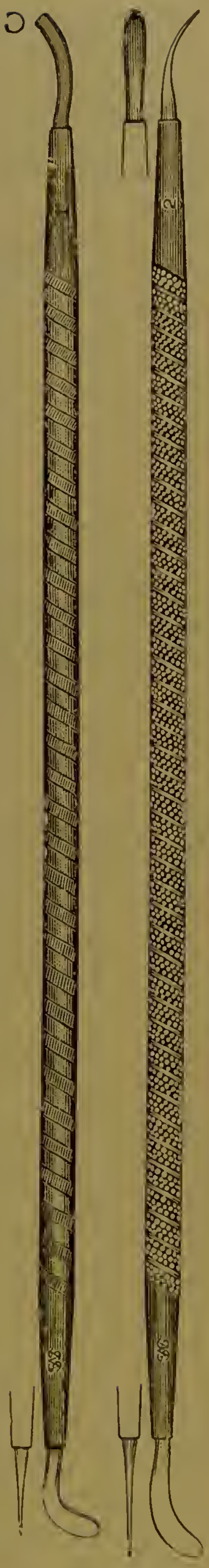

FIG. 386.

Fig. 387 represents the agate burnisher, which is considered by some to be superior to any other burnisher for surface finishing of oxychlorid and oxyphosphate fillings.

Fig. 388 represents the points of different forms of spatulas for mixing the zinc preparations, which is conveniently done on a porcelain palette, such as is used by artists.

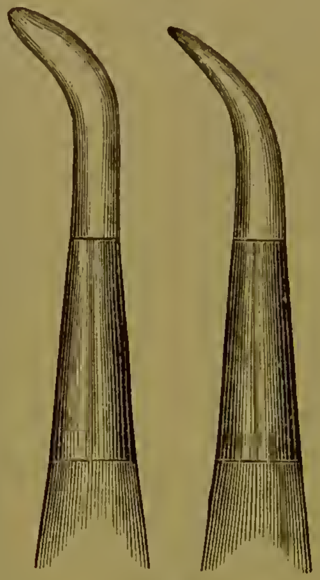

FIG. 387.

Fig. 389 represents a common form of mouth mirror, of which both plain and magnifying are used in examining the teeth. Dr. Maynard, of Washington, made an improvement in mouth mirrors, by substituting pebbles for glass, which more clearly reflect the objects they picture.

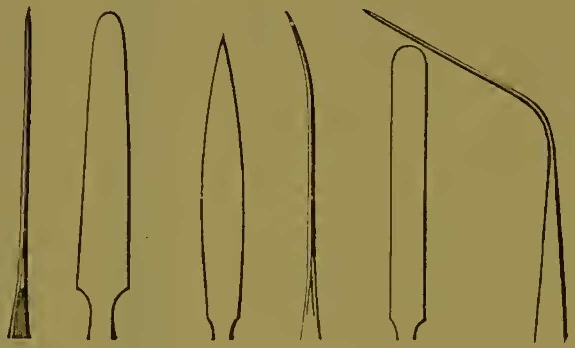

FIG. 388.

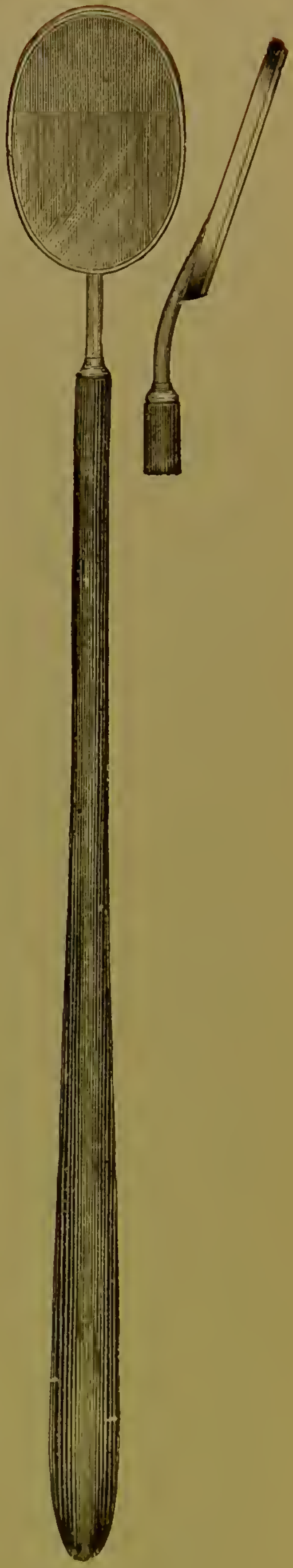

FIG. 389.

Fig. 390 represents reflectors for attachment to rubber-dam clamps, so that while providing a strong light, both hands of the operator are left free for manipulation. They are useful in operations upon posterior cavities in molars. By means of a ball-joint the mirror can be adjusted to concentrate the light upon the cavity or any portion of the mouth required.

Instruments known as stomatoscopes have been devised for the purpose of obtaining a perfect light for operations on the distal surfaces of molars and bicuspids, and are found to be especially useful when the sky is cloudy and for night work. Such instruments as the Grohnwald and Beseler stomatoscopes, which are capable of being so adjusted as to throw light to any part of the mouth necessary in filling teeth may be used. Dr. C. F. W. Bodecker asserts that by aid of a stomatoscope he was enabled to see up to near the apex of the pulp-canal of a palatal root of a first upper molar, the cavity being on the distal and grinding surface.

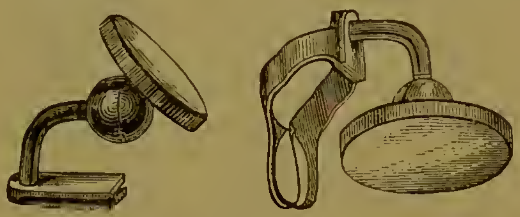
FIG. 390.

The electric light has also been utilized for the same purpose, and also for examinations of the throat, and even of the stomach. Mr. E. T. Starr, of the S. S. White dental establishment, succeeded in obtaining highly satisfactory results in this direction. His instrument consists of a lamp formed of a delicate glass bulb, from which the air has been withdrawn and as nearly a perfect vacuum created as possible. The bulb varies in shape, being spheroidal, flat, and compass-shaped, and also cylindrical, with a conical termination. Through the thin wall of the lamp run the conducting wires, connected by a carbon arc, on which the electricity centers, and which thus becomes the place of light. The glass lamp is very small, the cylindrical-shaped being scarcely half an inch in length, and with a diameter much less than that of an ordinary lead-pencil. The compass-shaped lamp is about one-quarter of an inch thick, and has a diameter of three-quarters of an inch to an inch, while the spheroidal is scarcely larger than a good-sized pea. The lamp is attached to a handle from seven to nine inches long and about half an inch thick, through which run the wires connecting with the battery. The intensity of the power and the brilliancy of the arc of light can be regulated by moving along the handle a ring which connects with the wires. The handle has several joints, and its position can be arranged so as to adapt it to the shape of the cavity it is to illuminate. Mirrors can also be fastened to the lamp, and light reflected to places where the lamp cannot be introduced. To prevent the too great radiation of heat and the diffusion of light, the lamp may be partially covered with a hard rubber or gutta-percha case. When the lamp is placed in the mouth of a patient, every portion of the throat, even to the lowest parts, and every recess of the upper places can be plainly seen. Placed behind the teeth, the intense light renders not only the teeth, but even the gums above, highly transparent. If the teeth are good and free from caries, no lines will be visible, but the presence of a filling or the beginning of caries may at once be seen. When the lamp is placed within the mouth, and the lips are closed, the entire front structure of the mouth is brought to view. No unpleasant sensations are experienced, even in cases of protracted use.

Fig. 391 represents the "Electric Mouth Lamp," or "Stomatoscope."

The electric mouth lamp will be found an invaluable assistant to the dentist in diagnosing lesions of the teeth and associate parts, especially in those obscure cases where, although there are unmistakable symptoms of serious pathological disturbance, careful examination with the appliances heretofore in vogue fails to discover the exact location of the trouble. Sound teeth are sometimes needlessly sacrificed in fruitless endeavors to find the seat of neuralgic pains for which, owing to the insufficiency of the means of diagnosis, no satisfactory cause can be established. The electric mouth lamp illuminates the oral cavity so brilliantly that any departure from normality, whether it be a hidden cavity of decay, an unsuspected dead pulp, or even the slight thickening of the tissues which is the precursor of decay, is unerringly detected.

This apparatus will also be found very useful in the operating room in other directions. In the preparation of inaccessible cavities it is often difficult to tell when the excavation has proceeded far enough, but the electric mouth lamp will show at once whether all the disintegrated tooth-substance has been removed.

In use the lamp is placed behind the object to be illuminated—that is, so that the object is interposed between the lamp and the eye of the observer. Thus, in examining the teeth the lamp is placed within the arch, so that its light falls upon the lingual or palatal surfaces of the teeth, while the eye of the operator is directed to the labial or buccal surfaces. So lighted, every portion of the teeth and gums is thrown into strong relief; the sound teeth will appear translucent and with no variations in texture, but a dead tooth will be at once detected by its opaque or dark appearance, even although to ordinary observation its color would indicate vitality. A cavity of decay, or any foreign substance about the teeth, will show as plainly as a spot upon a window-pane. A healthy root will not be distinguishable from the

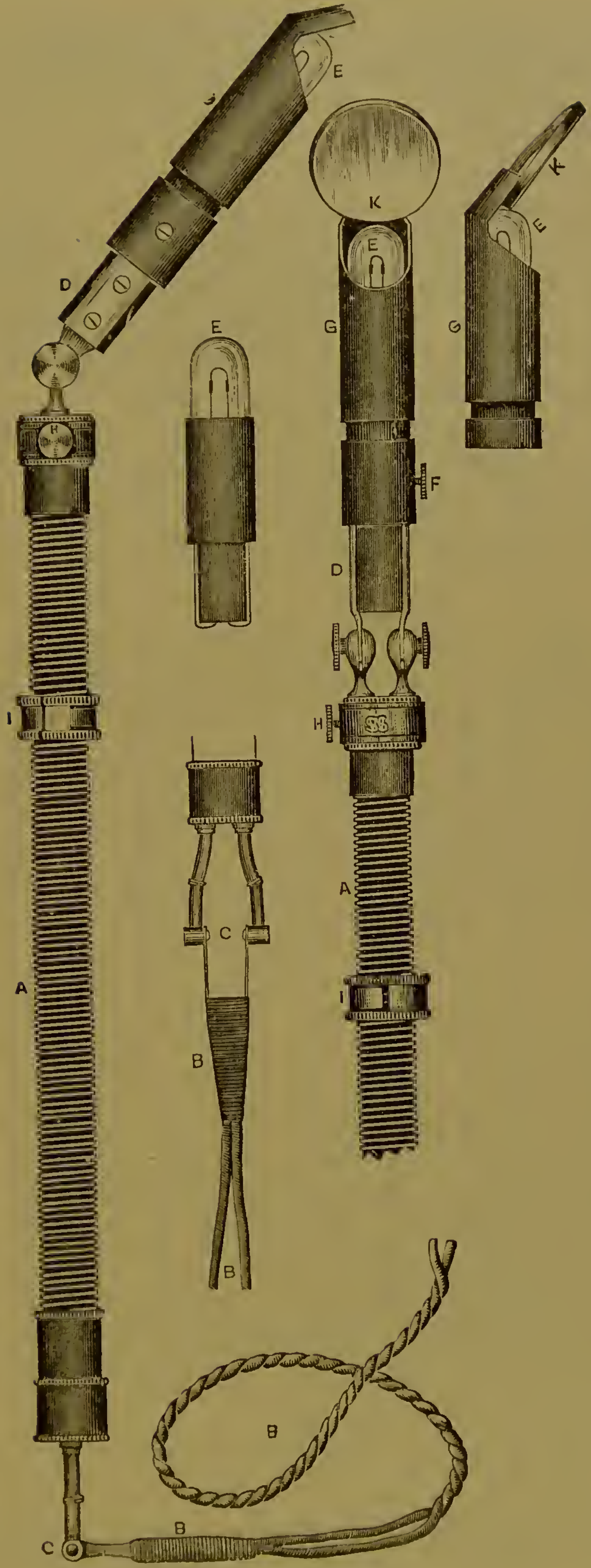

FIG. 391.

membrane surrounding it; but caries of the pulp-canal or any thickening of the tissues will be brought out by the illumination.

For the examination of posterior cavities in teeth a mirror is attached to the guard in front of the lamp globe, forming a perfect apparatus for the purpose.

It has been found impossible, so far, to make the lamps of exactly equal power, but the variation is not great. To develop their full capacity requires about 3½ to 4½ volts—say the current from two to three cells of a Bunsen battery. The cells of the battery supplied with the electro-magnetic mallet are excellent for the purpose, or three or four cells of any bichromate battery will answer.

The circuit should be broken occasionally during a prolonged examination, and also whenever the lamp is not in use, to prevent its becoming so hot as to be unbearable in the mouth.

For the examination of posterior cavities a mirror, set at an angle of 45 degrees, is attached to the end of the guard. With the mirror attachment the electric mouth lamp forms a perfect laryngoscope.

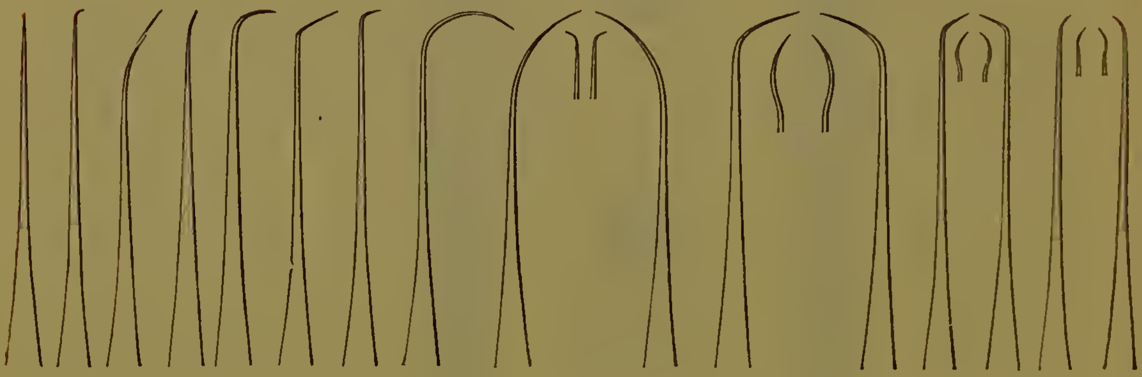

FIG. 392.

INSTRUMENTS FOR FORMING THE CAVITY.—Fig. 392 represents a set of instruments called "Explorers," useful for examining the teeth to determine the presence of caries. For the removal of the diseased part of the tooth and the formation of a cavity for the proper reception and retention of a filling, a variety of instruments are required, which should be constructed of the best steel and so tempered as to prevent them from either breaking or bending. Their points should be so shaped that they may be conveniently applied to any part of a tooth, and made to act readily upon the portion which it is necessary to remove.

The instruments employed for this purpose are chisels, excavators and burs. Fig. 393 represents some of the many forms of excavators in use. They may be formed either with handle and point in one piece or fitted to separate handles made of wood, ivory, pearl, or cameo, or be made to fit into one common socket handle, or for use in the engine. The introduction of cone-socket handles has supplanted all other styles of

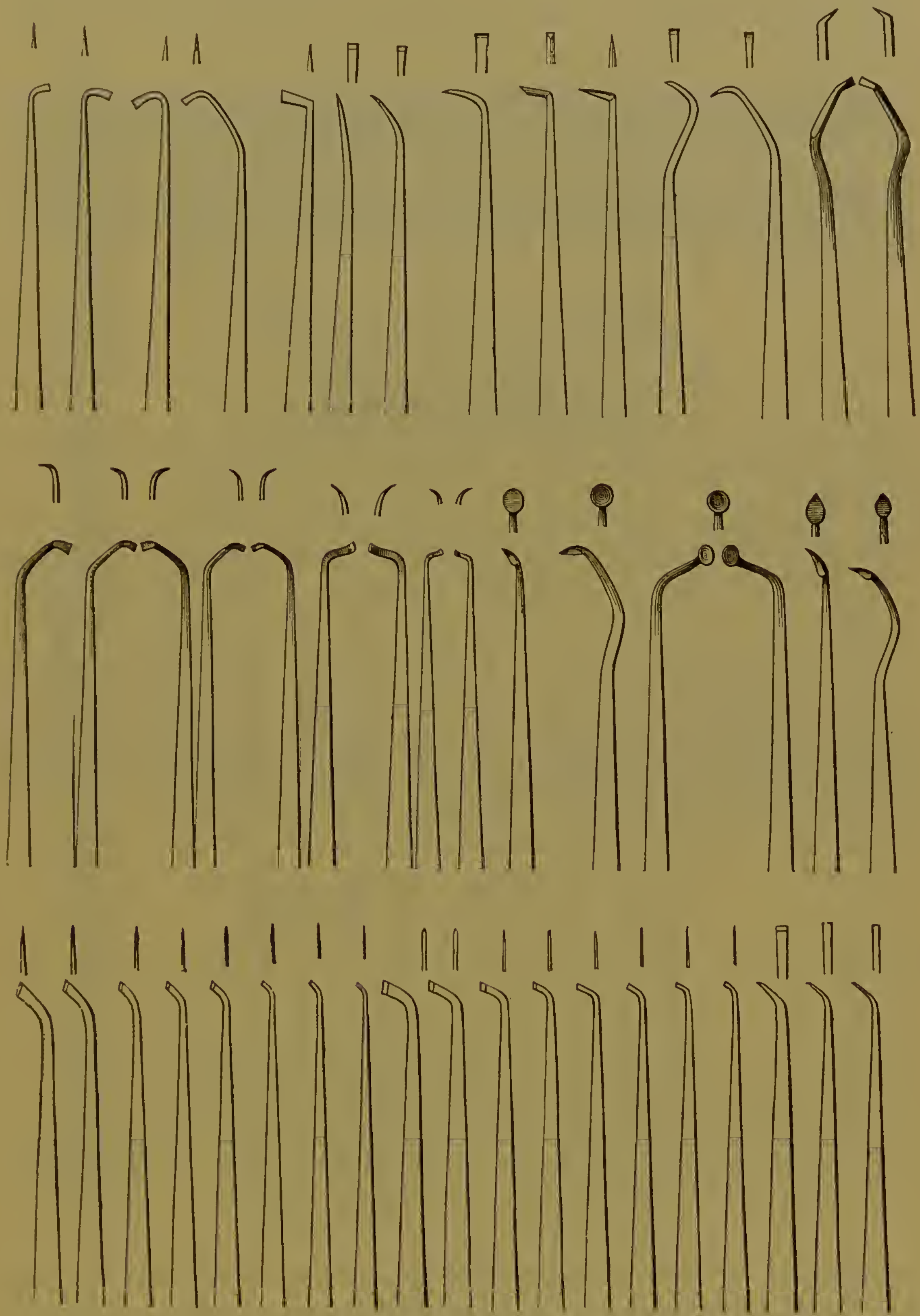

FIG. 393.

socket-handle instruments. These handles are made of steel, nicely engraved and nickel-plated. Fig. 394 represents such instruments.

Fig. 395 represents the form of plyers for screwing the points into the cone-socket handles.

Fig. 396 represents Dr. W. C. Head's approximal surface excavators, intended chiefly for use in preparing cavities between the upper front teeth, working from underneath, but are also useful on bicuspids where compound cavities are to be formed for contour fillings.

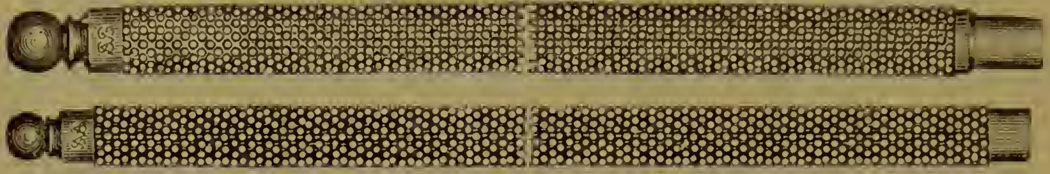

Fig. 394.

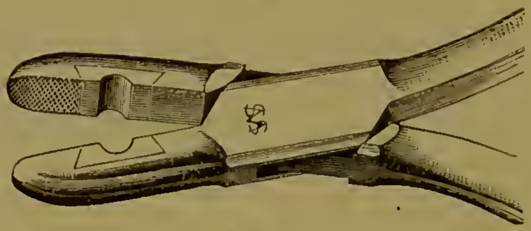

Fig. 395.

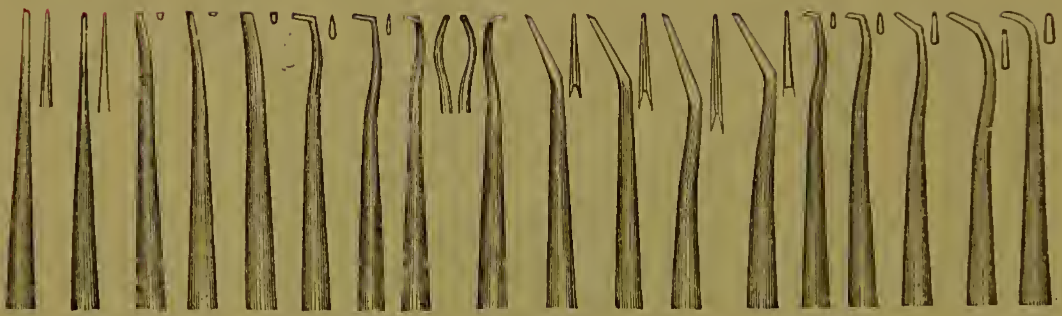

Fig. 396.

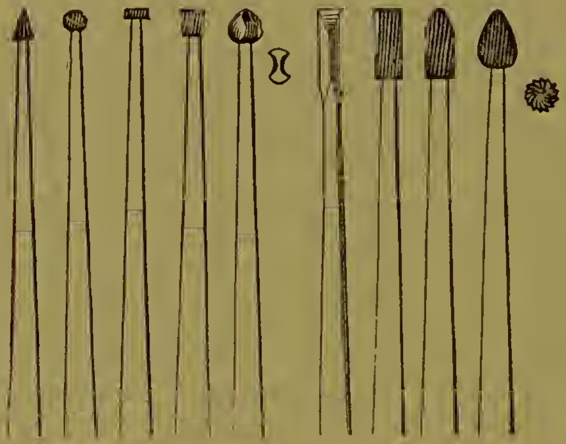

Fig. 397.

The flat and bur-headed drills represented in Fig. 397 are very useful for enlarging the orifice of a cavity. Fig. 398 represents a revolving head bur and drill socket, which carries burs and drills of all sizes. The clutch is operated by throwing forward or backward the section of the socket at A.

The use of excavating burs, by means of the dental engine, has almost supplanted the separate-handle drills. Fig. 399 represents a variety of forms of excavating burs and drills for use with the dental engine.

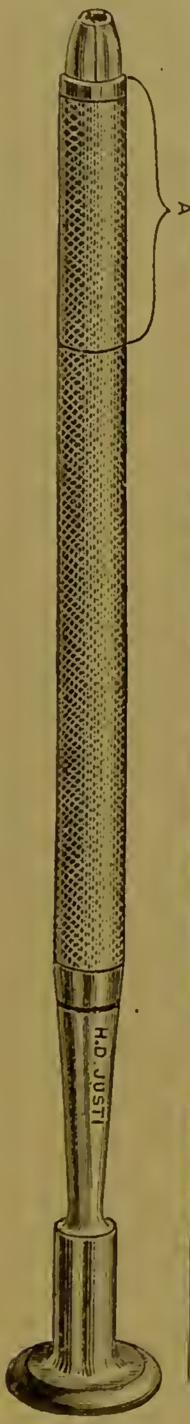

Fig. 398.

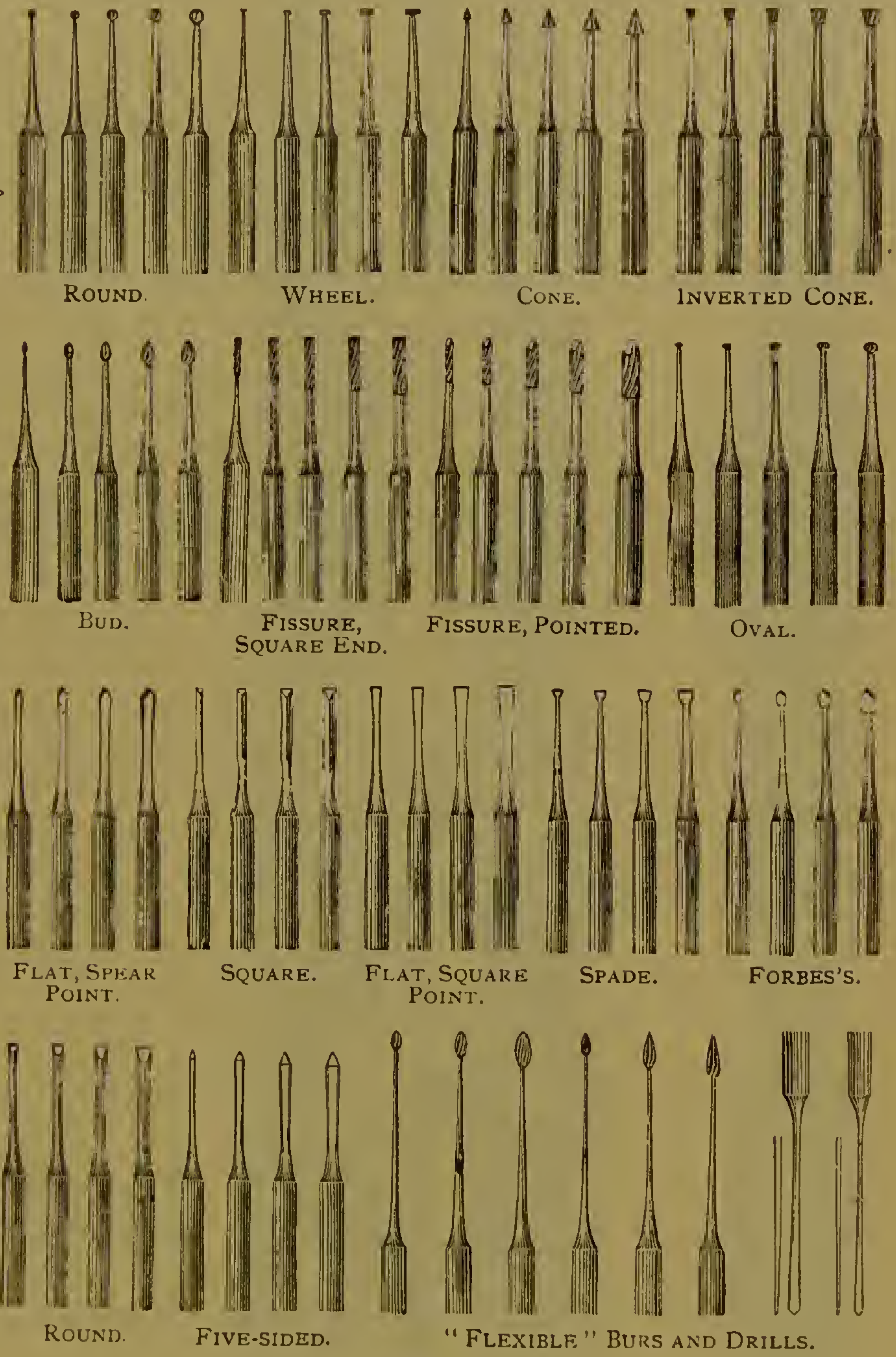

Fig. 399.

The Dental Engine is a valuable invention, for which the profession is indebted to Dr. Morrison, of St. Louis, and by means of which

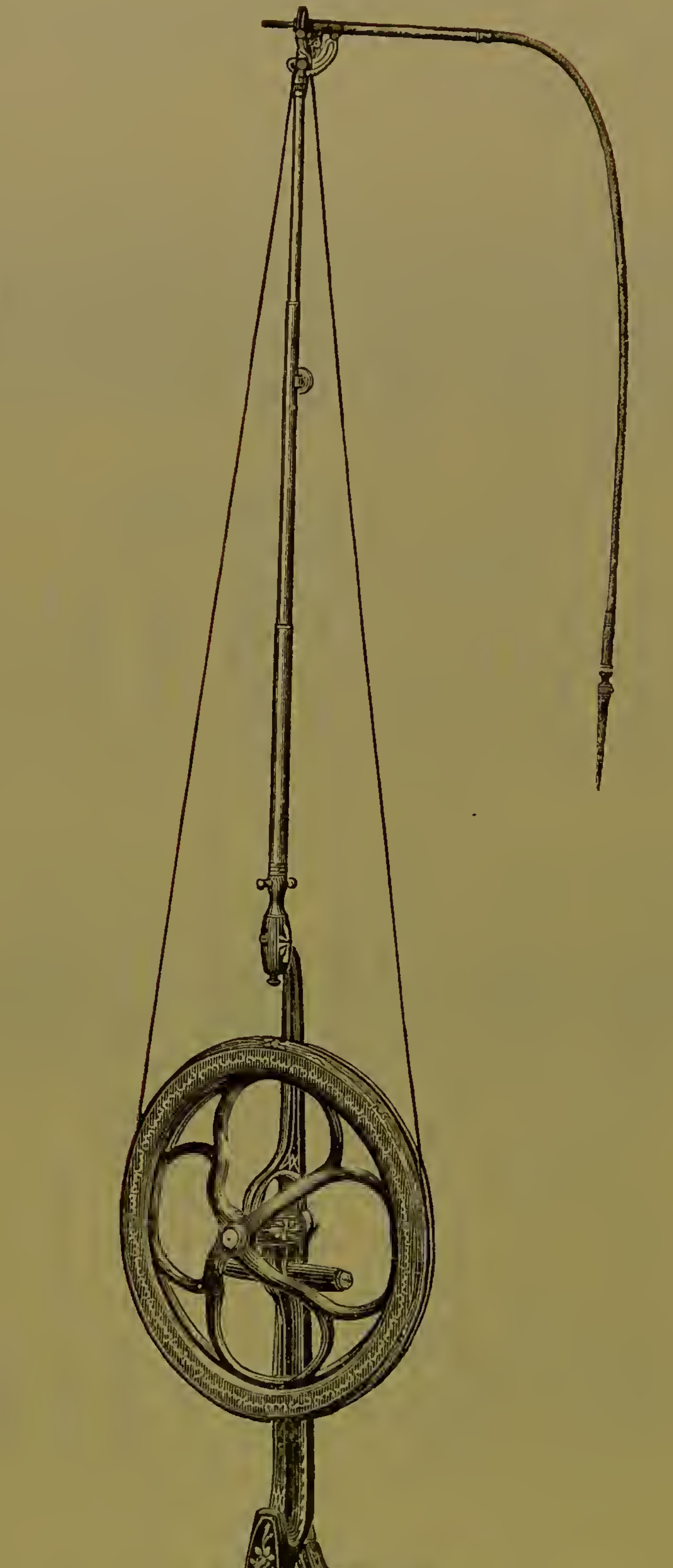

FIG. 400.

instruments, such as burs, drills, discs, condensing points, burnishers, wood-points, etc., can be rapidly revolved and effectively employed.

Figs. 400 and 402 represent two dental engines, a number of which are now in use.

Hand-Pieces, straight and angle, of various designs, and which hold burs, discs, points, etc., are attached to the cable or arm of the dental engine. Some of these hand-pieces are represented by Fig. 401. The cable of a dental engine can be attached to a water-motor or to an electric wire, both of which make efficient motive power.

Fig. 403 represents a rubber bulb chip syringe, for blowing the cuttings and dust from cavities in teeth by means of cold air.

Fig. 404 represents an elastic bulb syringe for cleansing cavities. The bulb is first compressed, and the point is then inserted under water, when it fills itself.

Enamel chisels of different shapes, and gouges, are also very valuable instruments for the preliminary operation of opening large cavities or cutting off sound enamel or dentine whenever necessary.

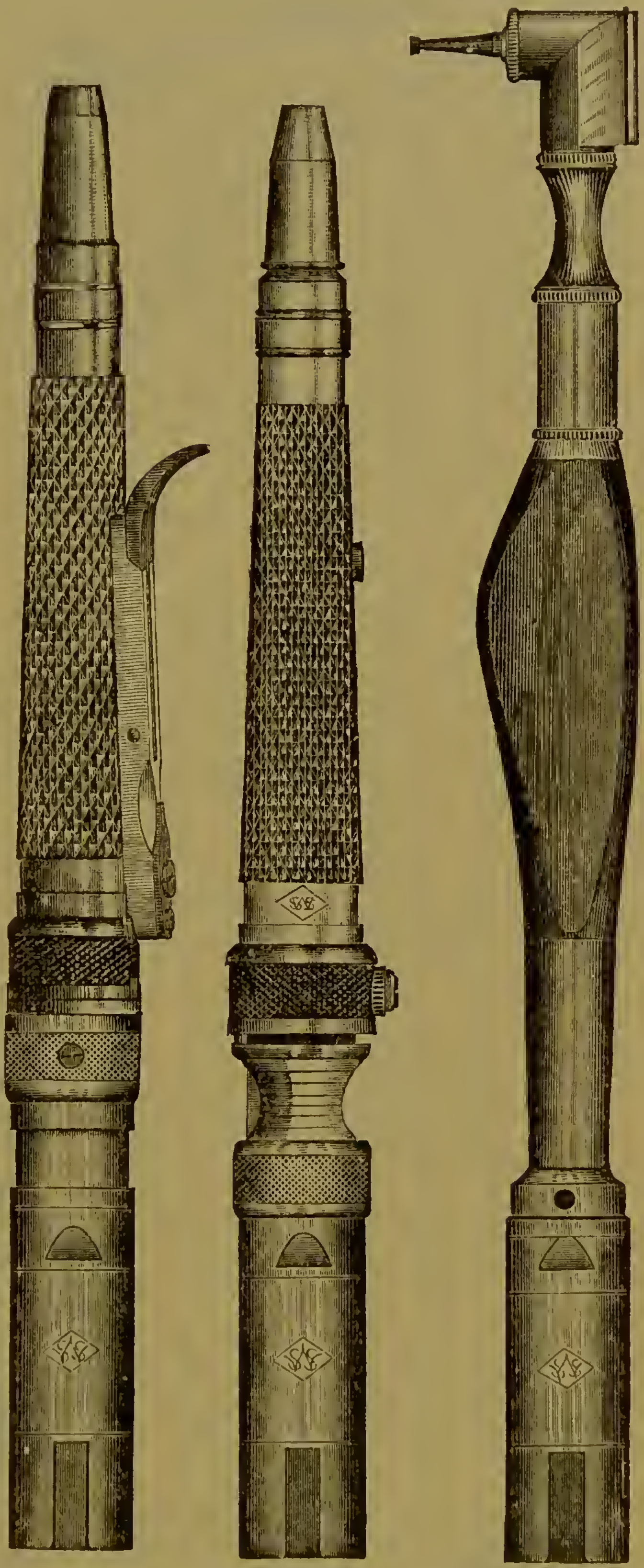

FIG. 401.

But the cavity can seldom be completed with such instruments. After it has been opened and the orifice made sufficiently large,

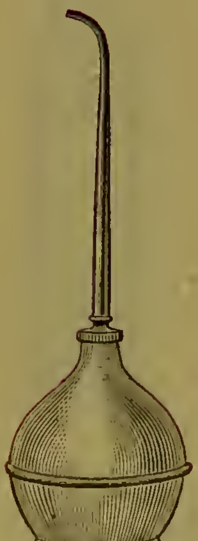

FIG. 403.

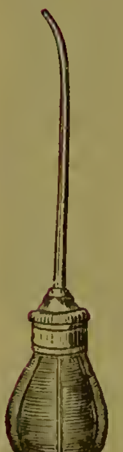

FIG. 404.

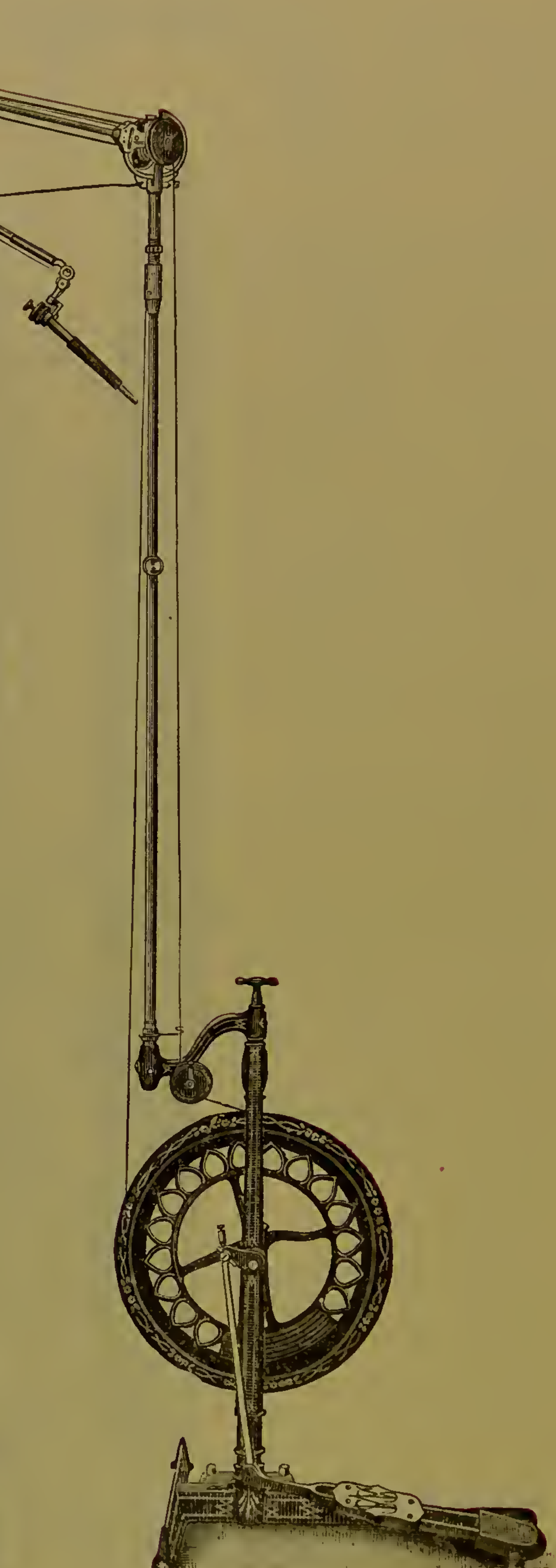

FIG. 402.

it should be finished with excavators (Fig. 393) and burs (Fig. 399) properly adapted to the purpose; in fact, in the majority of cases it should be wholly formed with instruments of this sort.

Excavators, shaped like those represented in Fig. 393, have been found by the author to be as well adapted for the removal of caries as any which he has ever employed. There should be several sizes of each shape; also duplicates of each instrument, to prevent delay in case of accident while operating. As the proper formation of the cavity greatly depends on having suitable instruments, every operator should be provided with a large supply of bur drills and excavators, so that he may never be at a loss for such as the peculiarity of any case may require. He should also have the material, and know how, in an emergency, to point his own excavators. For this purpose he will need a lamp, a small anvil and hammer, a set of fine-cut files, such as are used by watchmakers, and an assortment of steel rods of various sizes and of the best quality. It is not our purpose to give specific directions for working steel, but we would offer two cautions: first, small points quickly become brittle by hammering and need frequent annealing; second, steel is greatly injured by raising it to a full red or white heat. A very fine temper may be given, after shaping the point, by heating to redness and suddenly plunging it in wax or tallow.

As excavators must be kept very sharp, an oil-stone should be constantly at hand. The Arkansas, Hindostan, or Superior stones are superior, for this purpose, to all other varieties, on account of their hardness, fineness, and sharpness of grit.

Manner of Forming the Cavity.—The preparation of the cavity in a tooth for the reception of a filling is a very essential part of the operation, and, though usually the easiest, is sometimes attended with much difficulty. The removal of the diseased part is sometimes all that is necessary preparatory to the introduction of the gold, but in the majority of cases the cavity must be so shaped as, when properly filled, to retain the filling in place.

Where the orifice to a cavity is small and contracted it should be enlarged, by means of a bur drill, sufficiently to allow the use of excavators to remove the softened dentine. Small cavities may not only be enlarged, but cleaned and formed, by the drills.

Some prefer excavators in the form of scoops, for the removal of the softened dentine, which should be completely removed, and a dense, normal surface reached, due regard being had to avoid injury to the pulp of the tooth. A knowledge of the anatomical structure of the teeth will enable the operator to avoid penetrating to dangerous points when excavating cavities. Burs operated by the dental engine can be applied at almost any angle, and prove very serviceable in preparing cavities for fillings.

The part of the tooth surrounding the orifice should present no rough or brittle edges. The size of the bottom of the cavity should be as near that of the orifice as is possible, even a little larger, rather than any smaller. But the difference between the size of the one and the other should never be very great; for if the interior of the cavity is much larger than the orifice, it will be difficult to make the filling sufficiently firm and solid to render it absolutely impermeable to the fluids of the mouth.* If, on the other hand, the orifice is larger than the bottom of the cavity, it will be difficult to obtain sufficient stability for the filling, so as to prevent it from ultimately loosening and coming out. It often happens, however, that the situation and extent of the decay is such as to render it impossible to make the cavity so large at the bottom as at the orifice; when this is the case, several pits or circular grooves should be cut in the inner walls, for the purpose of obtaining as much security for the filling as possible; being careful to make these in the dentine rather than in the enamel, which is so much more brittle. By proper attention to this precaution, a filling may be so inserted in this difficult class of cases as to prevent it from coming out.

As a general rule it is easier to form a cavity in the grinding surface of a molar or bicuspid than in any other position; though it sometimes happens that even here it is attended with difficulty, and especially when the decay, commencing in the center, follows the several depressions which run out from it. In such cases the edges bordering on and covering the affected parts, which are often thick and very hard, should be cut away, together with the subjacent decayed dentine; the radiating depressions should open fully into the central cavity, and be made sufficiently wide and deep to admit of being filled to their extremities in the most perfect and substantial manner. The surface of a filling occupying a cavity of this kind presents a sort of stellated appearance. When two or more decayed places are separated only by very thin walls of tooth-substance, these should be cut away, and a cavity formed large enough to include all the diseased points; as one large filling will secure the preservation of the tooth more effectually than by filling each cavity separately.

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* Place a lump of cotton in the hollow of the hand formed by bringing the ends of the fingers against the palm. Then press with an instrument upon the center of the cotton, and it will leave the sides of the cavity. This simple illustration, suggested by Dr. Edward Maynard, will explain the cause of failure, in certain cases which have come under his notice, from the hands of operators of deservedly high reputation. The cavity, smallest at the orifice, had been well filled; but the final compression upon the center had drawn the gold from the sides, thus permitting the access of fluids, and ultimately decaying the tooth around the filling.

Sharp angles should be avoided, as far as possible, in the outline of the orifice of the cavity, because of the extreme difficulty of filling them compactly. The orifice must also have a firm, decided margin, with no thin projecting edges of enamel on the one hand; with no countersunk depressions on the other. In the first case the thin enamel is apt to break off either during the operation or subsequently; in the second case the thin scale on the edge of such fillings breaks away in the course of time; in both cases the filling fails perfectly to answer its purpose in the preservation of the tooth.

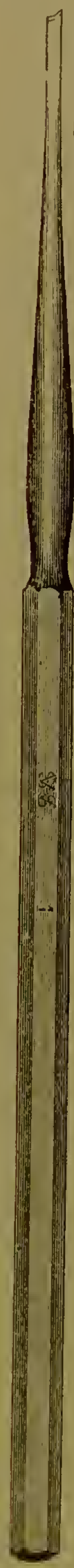
The enamel edges of every cavity, in preparing it for the introduction of a filling, should be smoothed by means of enamel chisels or the margin chisels, or the stone wheels and points, so that it may be somewhat countersunk. Too much care cannot be taken to properly prepare the enamel edges, as the perfection of the filling depends in a great measure upon the adaptation of the gold to such edges or margins.

It is preferable, in many cases of front approximal fillings, to cut away the inner angles of the tooth, thus avoiding the injury to the external appearance of the tooth caused by the file, etc. Upon completion of the operation, the surface thus cut is perfectly polished, as every filled or cut surface upon the teeth should be, and so shaped as to be kept readily cleansed with the brush or with floss silk. It is also very important that all parts of the cavity should be accessible and free from moisture before the introduction of the filling.

All *débris* accumulating during the cutting away of softened dentine and the formation of the cavity should be removed, either by the syringe with tepid water, or blasts of air, the latter being preferable where it is desirable to keep the cavity dry during the entire excavation.

In forming a cavity for the reception of cohesive gold foil, it is very necessary that it should be of such a shape as to retain securely the first gold introduced, and to accomplish this one or more small cavities, called retaining points, can be made within the larger cavity. These retaining points in many cases afford anchorage for the entire mass of gold composing the filling, and in every case where cohesive forms of gold are used, they are the support in the building up from the bottom to the orifice of the cavity.

These retaining points are formed in the dentine by means of a small, square, chisel-edged spear, or spear-shaped drills, and can very often be made of one sixteenth of an inch in depth; a less depth, however, will answer in many cases. One of these retaining points in connection with one or two under-cuttings on the opposite wall will be sufficient in some cavities, while in others two or three are required. The gold should be introduced into these retaining points in such a manner as to form, when they are filled, solid masses of



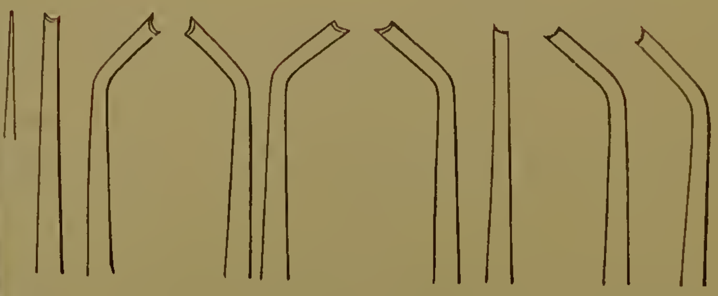


Fig. 405.

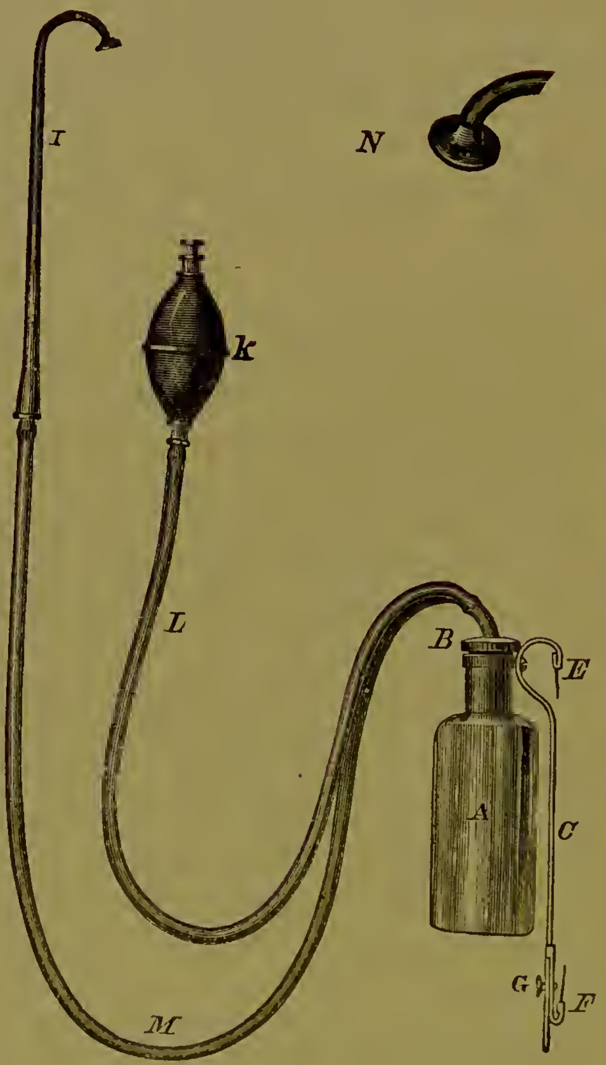


Fig. 406.

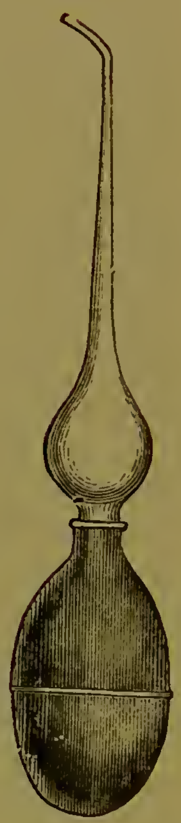


Fig. 407.

metal, which would require considerable force to dislodge them. Upon these solid masses the gold filling the cavity is built.

Fig. 405 represents a set of Dr. E. S. Talbot's Margin Chisels and Pluggers, for cutting, rounding, and smoothing the edges of cavities, leaving them in a condition to receive the gold, which should be adapted accurately to the margins.

Protecting Cavities from Moisture.—The first step in this operation is to wipe the mucous membrane covering the parts about the tooth to be filled perfectly dry, as well as the mouth of the duct of the nearest salivary gland, from which saliva may flow in such a manner as to interfere with the operation of filling the cavity. Before the introduction of the rubber-dam the following method was pursued to protect cavities from moisture: Over the mouth of the duct a roll of bibulous paper was placed, upon which rested one part of a napkin, which was so arranged about the tooth as to prevent the mucous secretions from reaching the cavity. The napkin was held in place by the thumb and fingers of the left hand. The remaining portion of the napkin could be used to prevent the breath from coming in contact with the material used for filling, as well as the cavity. When this was accomplished, the cavity was dried, as hereafter described, and was then ready for the filling. Much more difficulty was met with in protecting cavities in the inferior teeth from moisture than in the case of the superior, and various appliances were devised to overcome it.

The common saliva pump (Fig. 407) is used to remove the saliva as it accumulates in the lower part of the mouth, and consists of a glass tube with an elastic bulb.

Fig. 406 represents a very superior saliva pump. *A*, bottle or reservoir. *C*, clamp, furnished at its upper and lower ends with two steel pins, *E*, *F*, to secure it to the upholstery of a chair, so that it cannot be detached by accidental force. When used, the hard-rubber mouth-tube, *I*, is held in the mouth by one hand of the patient, and the bulb, *K*, in the other. Whenever saliva accumulates, the patient presses the bulb, and the saliva flows into the reservoir. The reservoir is emptied by unscrewing the cap, *B*. A very ingenious improvement on this instrument has been recently made for attachment to the "fountain spittoon," the current of the water causing a constant automatic suction, by which the instrument is operated and the mouth kept free from saliva.

Fig. 408 represents the Adjustable Fountain Spittoon with the Saliva Pump attachment.

The Rubber Dam.—For one of the most simple, yet effective, appliances for controlling the flow of saliva and protecting cavities from

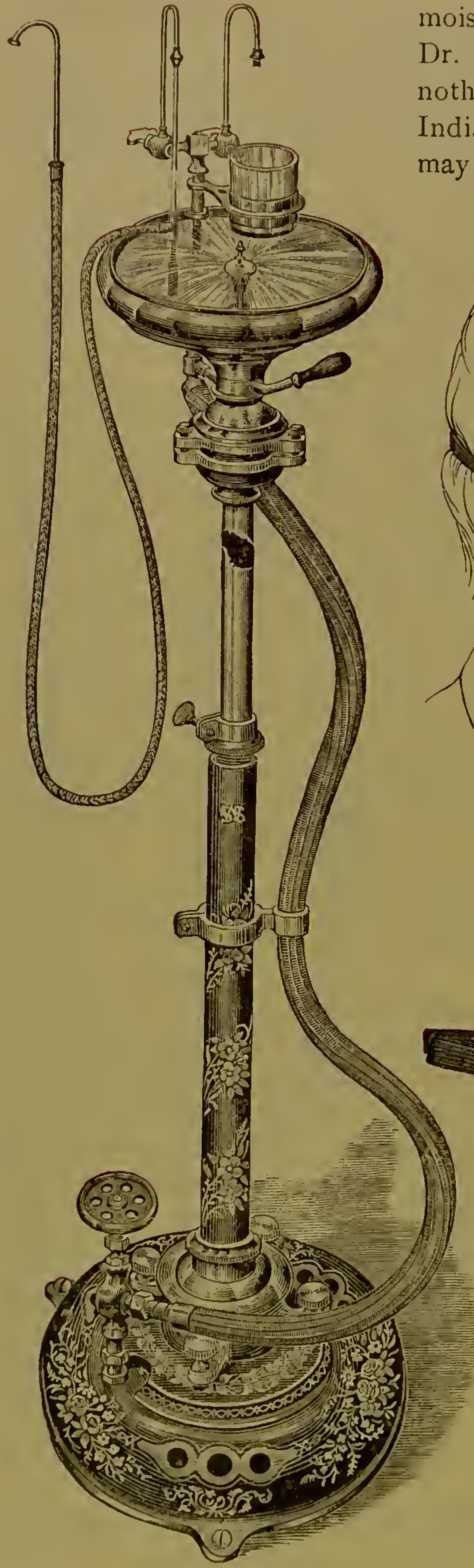


FIG. 408.

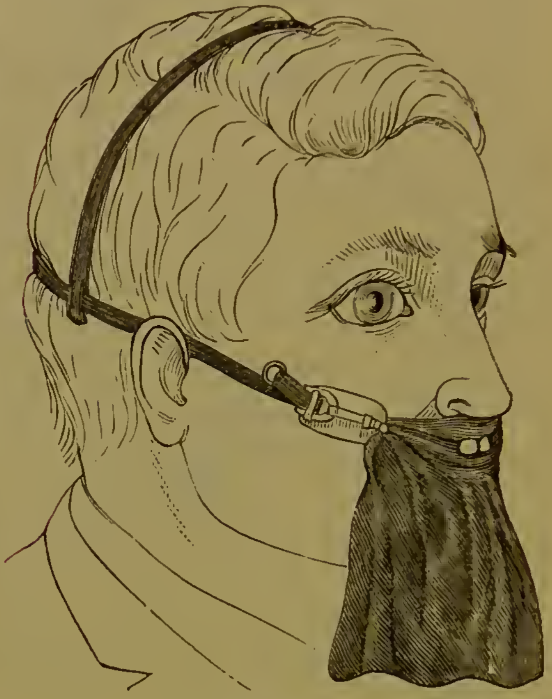


FIG. 409.

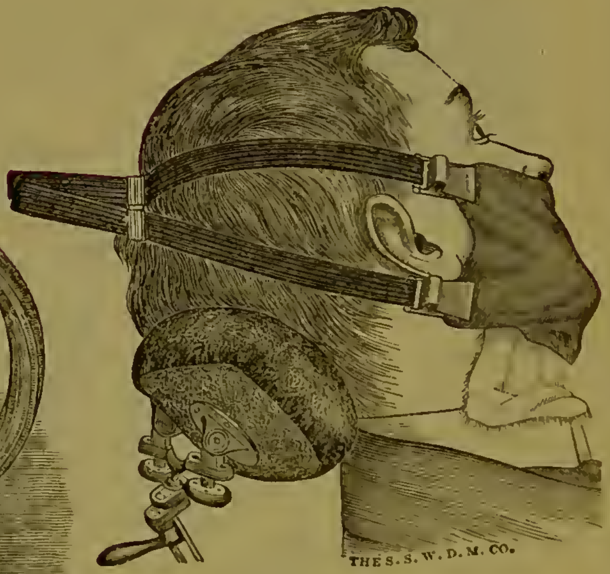

THE S.S.W.D.M.CO.

FIG. 410.

moisture we are indebted to the late Dr. S. C. Barnum. It consists of nothing more than a thin sheet of India-rubber, of good quality that it may possess sufficient strength and not tear easily, and of a thickness double that of letter paper.

Some distance from the edge of the sheet, which is from four to eight inches square, one, two, or more holes are made, through which the crowns of the teeth are passed when it is applied to the mouth.

The holes made in the rubber should be about one-tenth smaller in diameter than the necks of the teeth they are to embrace.

Fig. 409 represents the Rubber Dam in position, and Fig. 410 represents a "dam holder" in connection with the rubber dam.

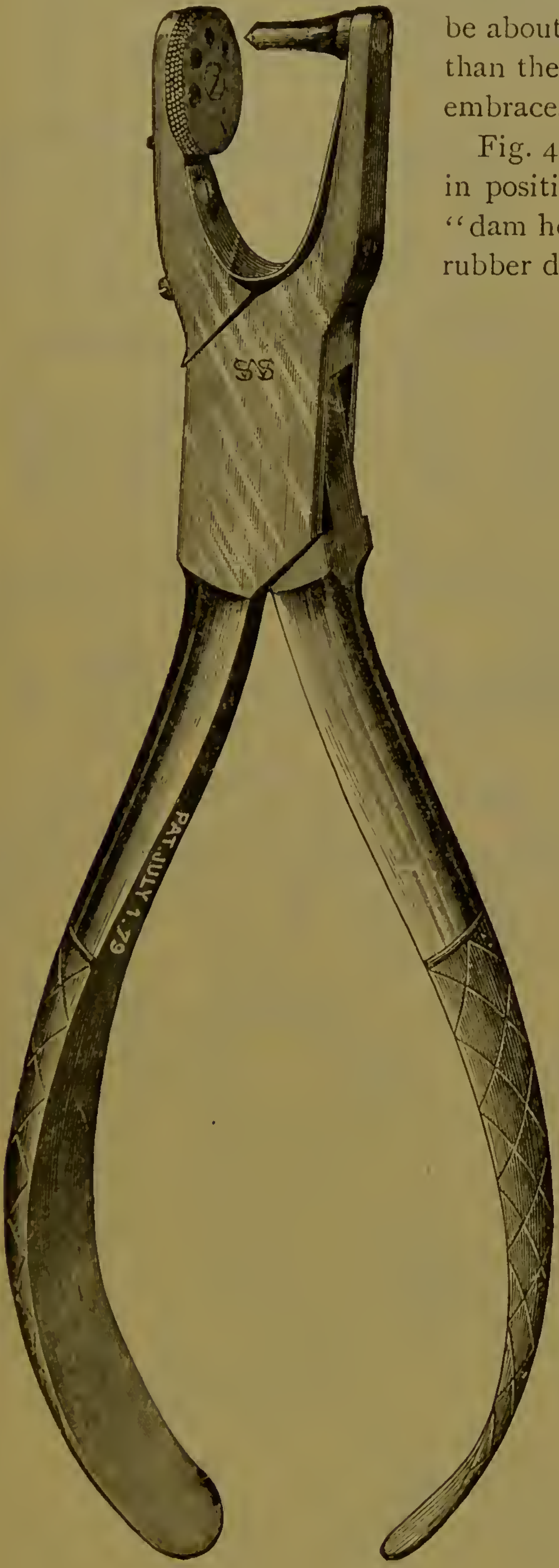


Fig. 411.

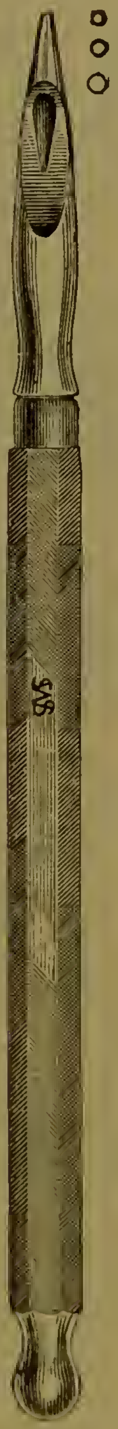


Fig. 412.

It is better in all cases to make several of these holes in the sheet, in order to include within the coffer-dam formed when the sheet is in position the crowns of the teeth adjoining the one in which the cavity to be filled is situated. When the crowns of the teeth approximate closely, the holes should be made about one-eighth of an inch apart; if some space exists between the crowns the holes may be made at a greater distance from each other. These holes may be formed in the rubber by means of a small chisel-edged punch, Fig. 412, or by the Ainsworth punch, Fig. 411.

The rubber, thus prepared, is carried between the teeth by either a thin, flat burnisher, or, which is better, by waxed floss silk, and the margins of the holes pressed gently under the free edges of the gums in the direction of the roots of the teeth.

These margins should be secured to the necks of the teeth by means of waxed floss silk tied around them, or by the use of suitable clamps, such as are now manufactured for that purpose.

Fig. 413 represents an "Applier" for the use of waxed floss silk in adjusting the Rubber Dam.

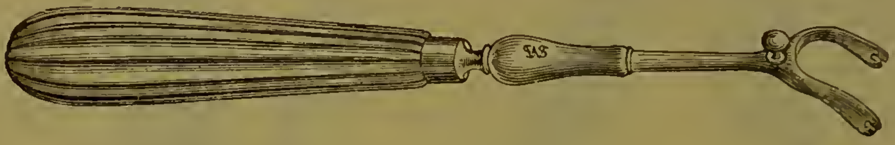


FIG. 413.

Fig. 414 represents some of the many forms of Rubber-Dam Clamps, used for securing the rubber dam to the necks of teeth. Forms of these clamps are made with tongue-guards.

Fig. 415 represents the Rubber-Dam Clamp Forceps, by means of which the clamp, in connection with the rubber dam, is placed in position on the tooth.

Figs. 416, 417, and 418 represent the How, Johnson, Climax, and Ivory cervix screw-clamps, and the T. A. Long clamp.

Several other simple appliances are in use to protect cavities from moisture, such as wooden wedges forced between the necks of the teeth, and waxed cord surrounding the tooth in which the cavity is situated, and passing to an adjoining tooth; also a band of rubber cut from tubing, which is placed high up on the neck of the tooth and then carried around an adjoining one. Two of these bands, acting in opposite directions, answer better than a single one, and in many cases effectually protect this cavity from moisture.

Drying Cavities.—After every particle of decomposed dentine has been removed, the cavity should be thoroughly cleansed before the filling is introduced. This may be done by first injecting tepid water

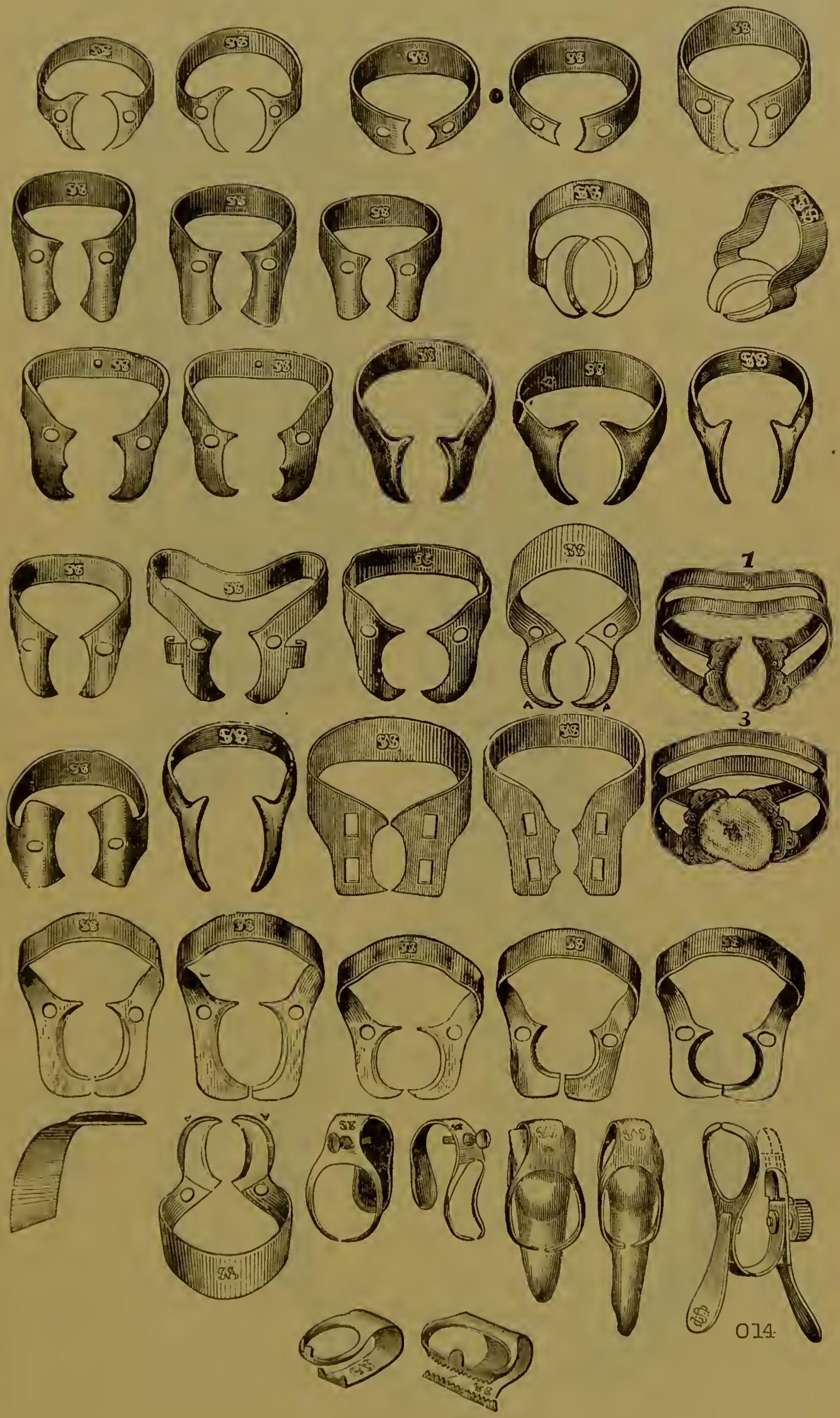


Fig. 414.

into it with a properly constructed syringe, and afterward wiping it dry with a small lock of absorbent cotton fixed upon the point of a

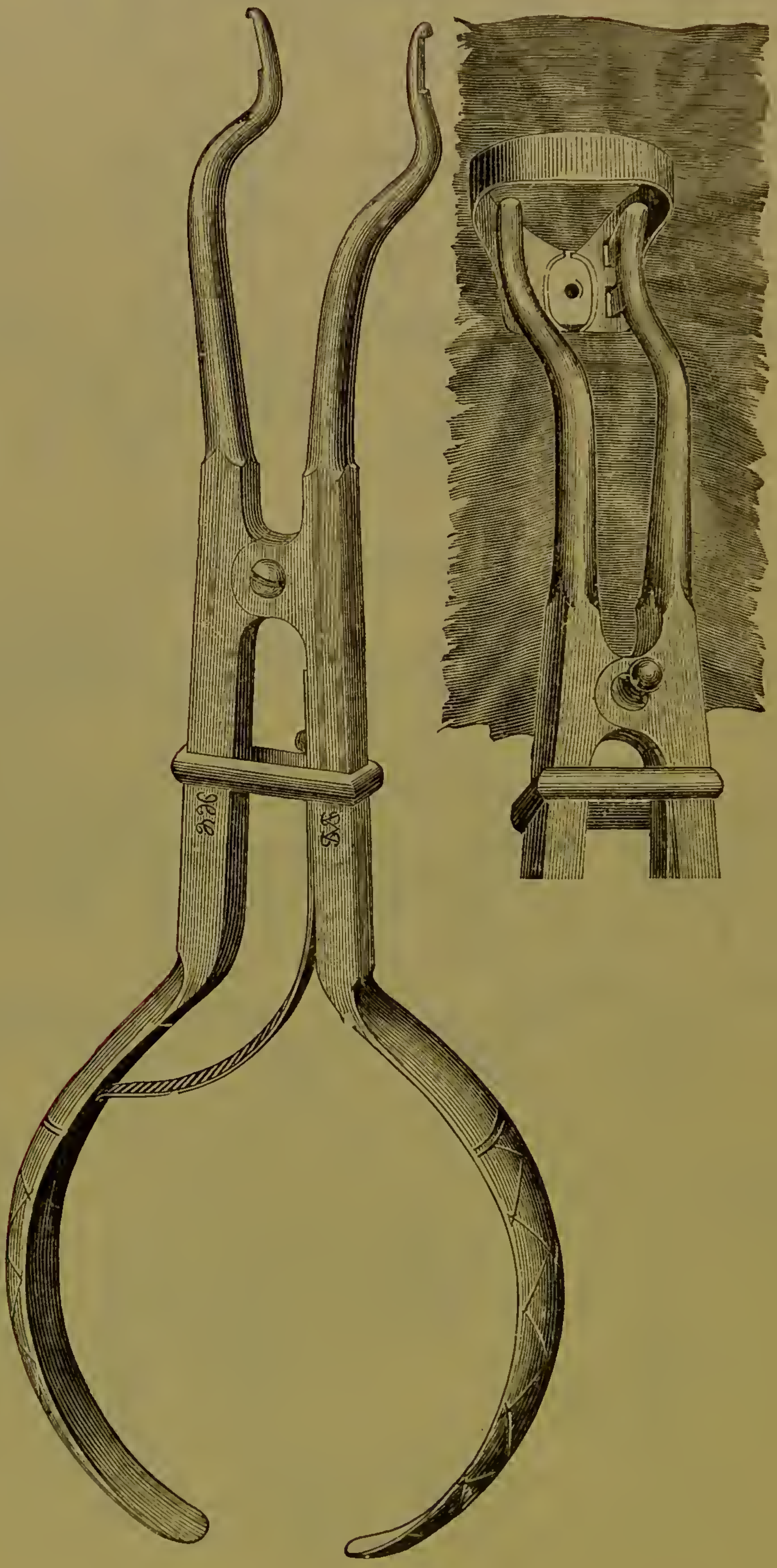


FIG. 415.

probe or excavator; or the cavity may, in the first place, be wiped with a little raw cotton moistened with water and afterward with absorbent cotton. The application of the cotton should be followed by that of Japanese bibulous paper, which has a very loose, absorbent texture, and may be folded, for convenience, in the form of a rope, from which the moistened end can be torn after each insertion. Tissue or bibulous paper absorbs moisture more perfectly than cotton. The absorbing qualities of cotton, however, may be increased by boiling it for fifteen or twenty minutes in a tolerably strong alkaline solution; this done, it should be thoroughly dried before using; or by saturating it with sulphuric ether to remove the natural oil. Several materials have been of late years used in drying cavities, such as prepared flax, fine and white, with a long, absorbent fibre, prepared spunk, absorbent

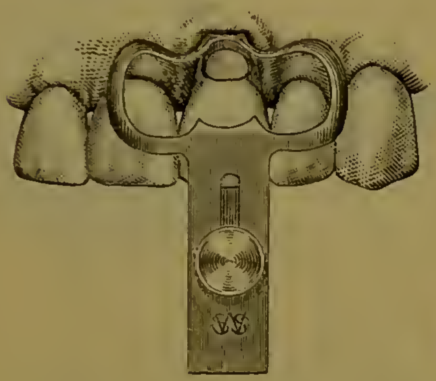


FIG. 416.

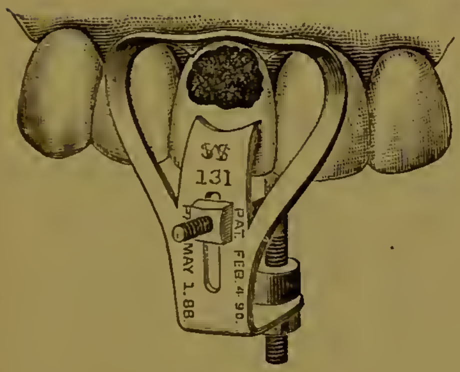


FIG. 417.

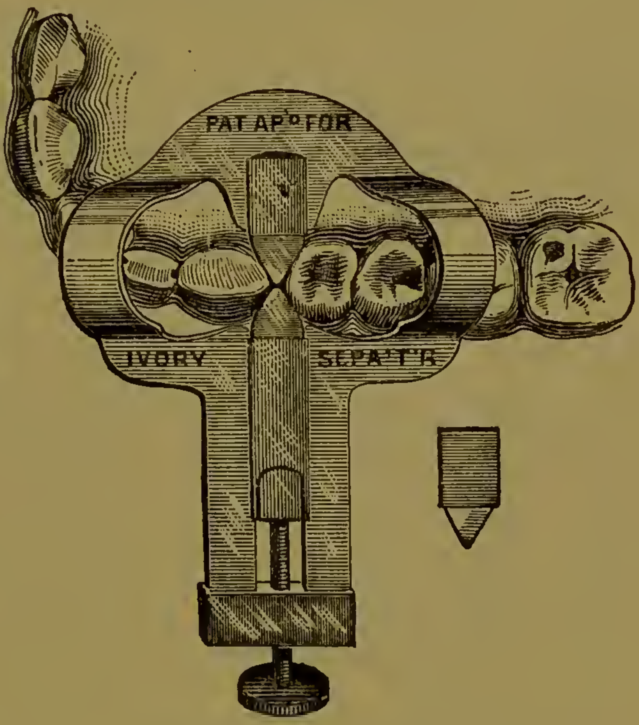


FIG. 419.

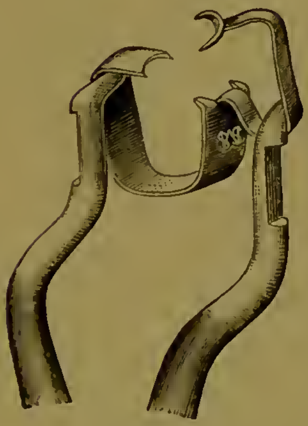


FIG. 418.

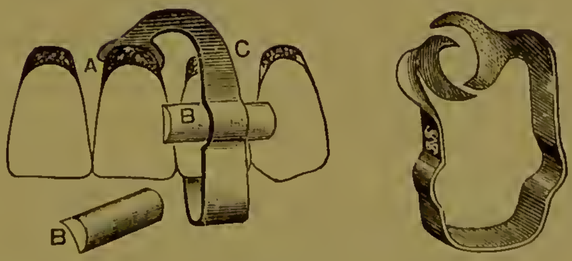


FIG. 420.

cotton. Fig. 421 represents a Hot-air Syringe for drying cavities, the heating chamber being filled with carbon, the best known retainer of heat. To fill this syringe with heated air, the turret of the air-chamber is held in the flame of a spirit-lamp; the turret, being provided with a metallic valve, recedes as the bulb, after being compressed, fills with air and allows the flame to be drawn into the chamber. It is desirable that the cavity should be perfectly dry before the filling is introduced.

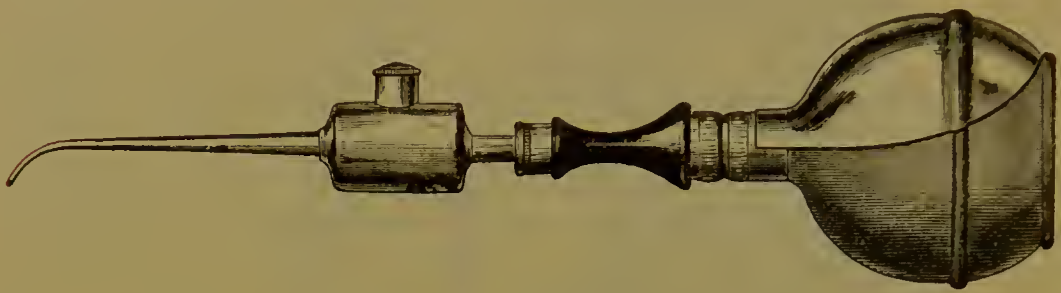


FIG. 421.

INSTRUMENTS FOR INTRODUCING AND CONSOLIDATING GOLD.

For introducing and consolidating non-cohesive gold foil, a number of instruments are required, which should be sufficiently strong to resist any amount of pressure the dentist can safely exert in the operation. Hand instruments should have round or octagonal handles, large enough to prevent the liability of being broken and to enable him to grasp them firmly. Their points should vary in size, though none should be very large. Several should be straight, but for the most part they require to be curved—some very slightly, others forming with the shaft of the instrument an angle of 90°. Fig 422 represents a set of small-pointed hand pluggers. For other forms the reader is referred to the chapter on " Filling Individual Cavities."

Plugging instruments, as received from the instrument makers, have usually a temper which will not permit them to be bent. It will add, we think, greatly to the value of the instrument if the practice of Dr. Maynard were more generally adopted. He gives to the extreme point a hard temper (straw color) to prevent it from wearing; for a little distance, say one to three-quarters of an inch, a spring temper is given (purple or blue color) to insure strength when the shape is delicate; the rest of the instrument is left soft, so as to admit of being bent (with pliers) in the direction best suited for that particular point in any given operation.

Most of them should have a slim wedge shape; some, however, both of the straight and curved instruments, should have blunt serrated points, and a few should have highly polished oval points, for finishing the surface of fillings. Formerly, most dentists employed, for introducing and consolidating the gold, simple blunt-pointed pluggers; but it is impossible with such instruments to make a filling as firm and solid as it should be for the perfect preservation of a tooth, especially if the cavity is large. From one-fourth to one-half more gold can be introduced into a tolerably large cavity with a wedge-pointed than with a blunt-pointed instrument.

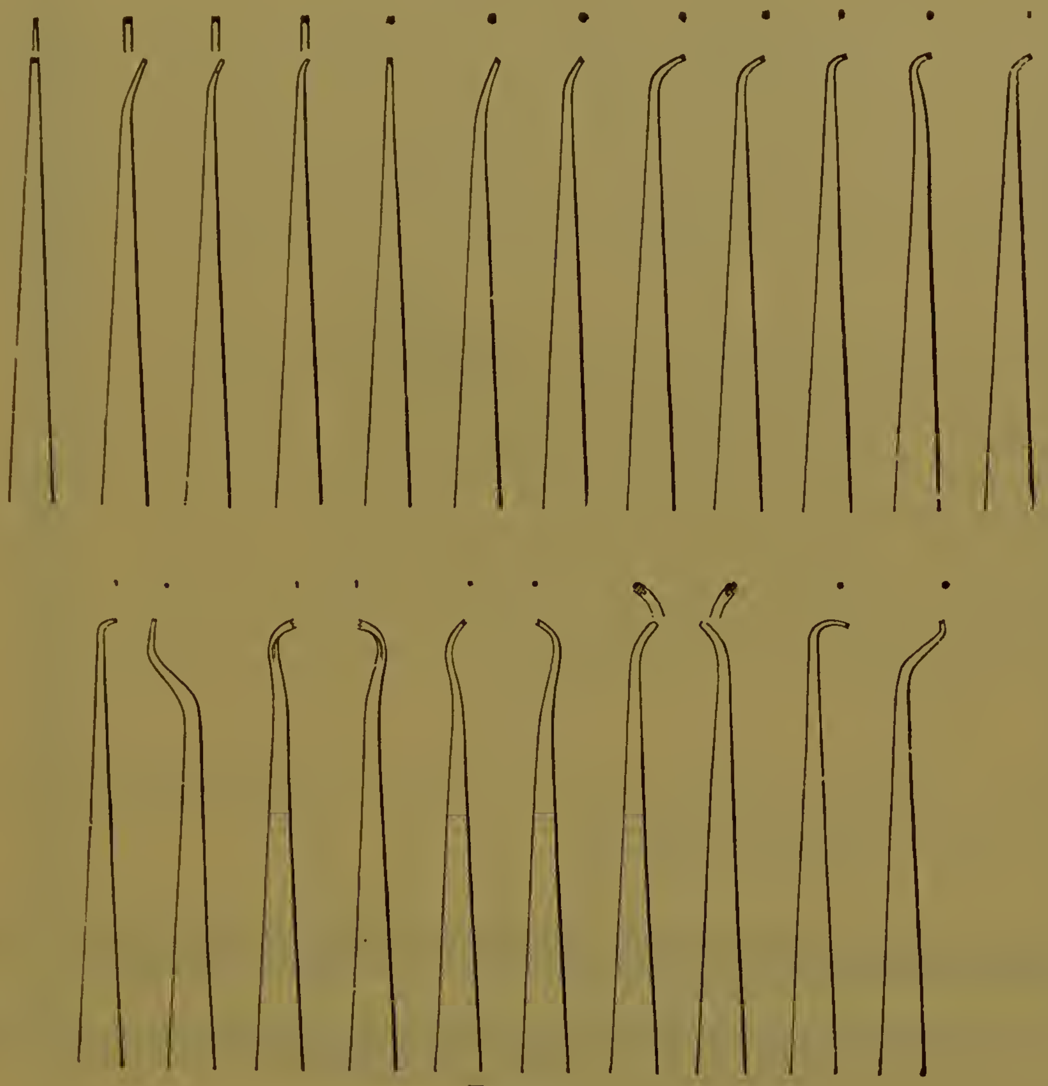


FIG. 422.

Fig. 423 represents an excellent set of points designed by Professor James H. Harris for use in solid or socket handles, and also with the automatic or hand mallet, and although intended for cohesive gold, can also be used for the non-cohesive.

This general description will serve to convey a tolerably correct idea of the kind of instruments required for the operation.

Instruments having serrated points are required for filling teeth with crystal or sponge gold and with cohesive gold foil.

Fig. 424 represents some knurled handles for cone socket plugger points.

Fig. 425 represents Dr. R. W. Varney's set of Pluggers for the cohesive form of gold foil.

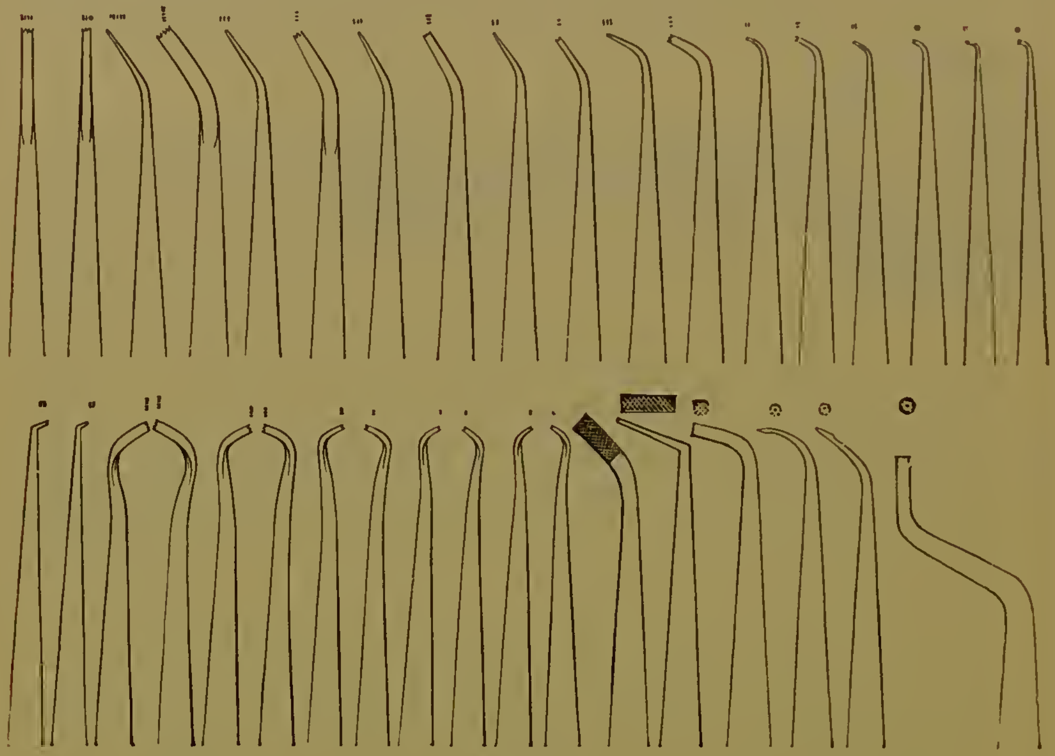


FIG. 423.

Fig. 426 represents Dr. Marshall H. Webb's set of pluggers, also for the cohesive form of gold foil.

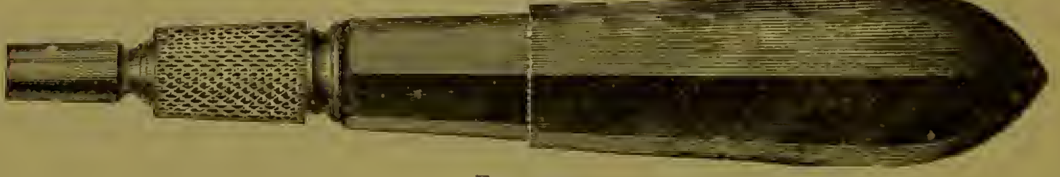
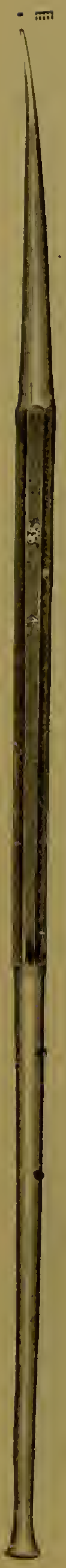


FIG. 424.

Fig. 427 represents Dr. Chapelle's malleting shaft pluggers, for the use of cohesive gold, especially No. 30 rolled cohesive gold, cut in strips $\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{16}$ inch wide and one inch long.



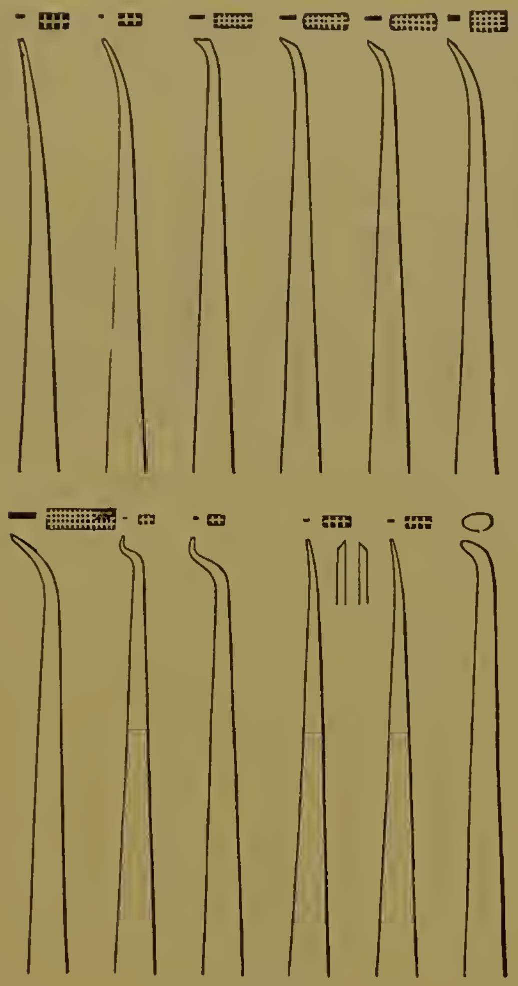


FIG. 425.

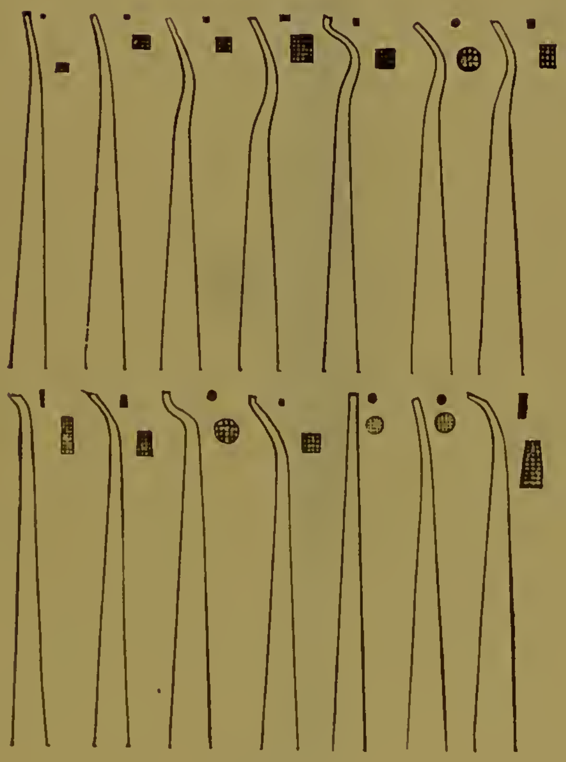
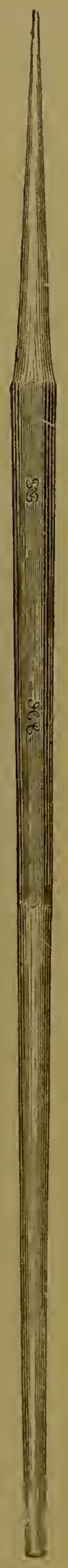
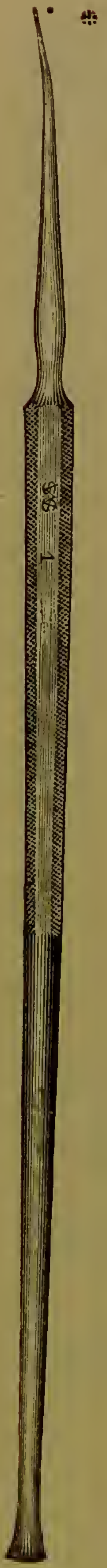


FIG. 426.





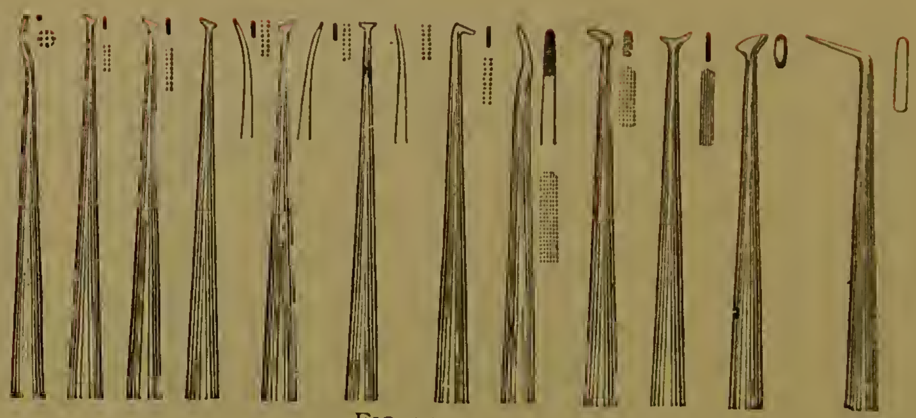


FIG. 427.

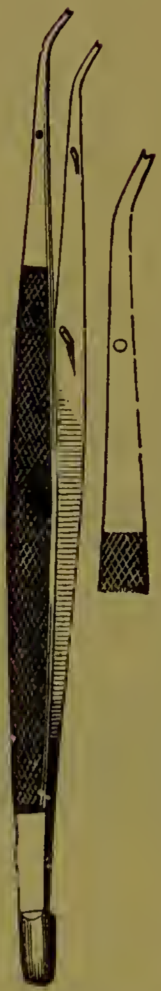


FIG. 428.

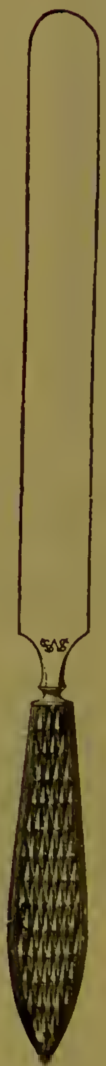


FIG. 429.

Fig. 428 represents a combined foil carrier and plugger, for taking up pieces of gold and placing them in the cavity and partially condensing them.

MANNER OF PREPARING, INTRODUCING, AND CONSOLIDATING GOLD, AND FINISHING THE SURFACE OF THE FILLING.

Non-Cohesive Gold Foil.—The operator, being provided with the necessary instruments, should cut this form of gold with a pair of foil-scissors into strips containing from one-fourth of a sheet to one whole sheet. Each of these should be loosely rolled or folded together lengthwise, by the aid of a foil-holder or spatula (Fig. 429), on a piece of soft spunk, covered with chamois skin or white kid—the foil-scissors and spatula have recently been combined into one instrument—and after the cavity has been properly cleansed and dried, the end of one fold should be introduced and carried to the bottom of the cavity, with a straight or curved wedge-pointed instrument; the roll on the outside should then be folded on the part first inserted. The folding should be commenced on one side of the cavity, and the inner end of each fold taken to the bottom, the outer extending nearly a twelfth or an eighth of an inch on the outside of the orifice; thus, fold after fold is introduced, until no more can, in this manner, be forced into the cavity. Having proceeded thus far in the operation, the instrument should be forced through the center of the filling and the gold firmly pressed against the walls of the cavity. The opening thus made should be filled in the manner as first described, and this time it should be packed in as tightly as possible. This done, the operator should endeavor to force a small, wedge-pointed instrument in the center of the filling, until he has tried every part of the plug, filling, as he proceeds, every opening which he makes, and exerting, in the packing of the gold, all the pressure which he can apply without endangering the tooth. If one roll or fold of gold is not enough, he should take another and another, until the cavity is thoroughly filled. When the walls of the cavity are frail it is the practice of some operators to introduce the gold rather loosely, and to depend upon surface condensing to obtain the necessary solidity. But it is better to well condense every fold immediately after it is carried to its proper place in the cavity; such condensing will often render the use of the wedge-shaped instrument unnecessary.

The advantage to be derived from introducing the gold in this manner is obvious. By extending the folds from the orifice to the bottom of the cavity the liability of the gold to crumble and come out is effectually prevented, and by introducing it with a wedge-pointed instrument it may be carried into all the depressions of the walls of the cavity, and rendered altogether more solid than it could otherwise be made. The cohesiveness of the gold may be increased by slightly warming in the flame of a spirit lamp, after it has been made into rolls or folds.

After the cavity has been completely filled, every portion of the projecting part of the gold must be thoroughly consolidated before it is allowed to become wet, with a small, blunt-pointed instrument, straight or curved, as may be most convenient; or, if the filling is in the approximal side of a tooth, it may be compressed with the angle of the point of the plugger, making the adjoining organ, to a slight extent, a kind of fulcrum for the instrument. After the filling has been thus consolidated as long as it can be made to yield in the least to the pressure of the instrument, the protruding parts may be scraped or filed off, down to the tooth, so as to form a smooth, uniform, gently swelling, or perfectly flat surface. Fig. 444 represents a number of finishing files. If in this part of the operation any portion of the gold should crumble or be dislodged, which it will not do if it has been properly introduced and consolidated, the injury may be repaired by making, in the part of the plug where it has occurred, an opening, and filling it, or by the removal of the whole of the filling and the introduction of another. If any portions of gold have been forced over the edge of the orifice of the cavity they should be carefully removed, either with a file or sharp-pointed cutting instrument suited to the purpose. This precaution should never be neglected, especially when the filling is in the approximal surface of a tooth, where a portion of the gold is very liable to be forced up or down upon the neck and under the gum. If the filling is located on a masticating surface, a flat and level gold surface will answer the best purpose in preserving the tooth-structure; if upon an approximal surface, the filling should be contour, as a general rule. Soft or non-cohesive gold foil, in the form of the ribbon or loosely-rolled cylinders, is frequently used in connection with cohesive gold foil as a base upon which to build the latter form of gold. This combination is especially applicable in the case of cavities upon the approximal surfaces of the teeth and which extend to the gum. The soft or non-cohesive gold in such cases is employed to cover over the cervical walls, being first introduced into one of the angles of the cavity, until this wall is completely covered, when mallet force is employed to condense the mass which has been introduced, with a fine foot-plugger. On this base of non-cohesive gold, pieces or pellets or the ribbon of cohesive gold are condensed, and the filling completed with the latter form of gold. The non-cohesive gold, owing to its quality of adaptability, is capable of being closely packed against the most vulnerable walls of cavities, where it may, in some cases, answer a better purpose in the preservation of the teeth than the cohesive forms would do in the same location.

Cylinder Filling.—The method of filling cavities with non-cohesive gold foil in the form of cylinders is a favorite one with many operators, and is in some cases, especially grinding surface cavities with firm walls, preferable to that of the fold or rope. A common method of preparing these cylinders is to fold lengthwise, in the form of a ribbon, either the third, half, or whole of a leaf of No. 4 or 6 gold foil; the width of the ribbon determines the length of the cylinders.

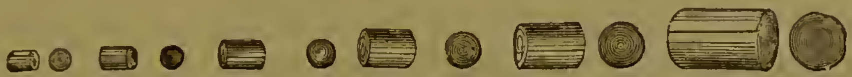


FIG. 430.

One end of this ribbon is then held between the thumb and index finger of the left hand, and wound upon a three- or four-sided broach until the cylinder thus formed is of the size desired, when the remaining portion of the ribbon is torn off.

The cylinders should be a little longer than the cavity is deep in order to allow for surface condensing. The density of the cylinders depends upon the tightness with which the ribbon is wound upon the broach; by winding it loosely upon the broach soft cylinders are formed, to be placed in contact with the walls of the cavity, while the hard cylinders made by tighter winding are introduced inside of the soft and form the center of the filling. Different forms as well as sizes of cylinders are necessary in every case, cone-shaped as well as the true cylindrical. The cone-shaped cylinders are useful where there is an under-cutting, and also for completing the introduction of the gold.

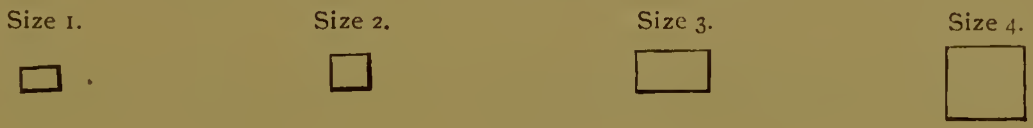


FIG. 431.

These cone-shaped cylinders are formed by winding the ribbon back from the point of the broach, which should taper slightly, in order that the cylinder when completed may be easily detached.

Loosely rolled cylinders, prepared ready for use, can be obtained of manufacturers (Fig. 430).

These loose cylinders are useful, applied to the cervical walls of approximal cavities, as a base upon which to build cohesive gold foil.

Also the blocks or mats represented in Fig. 431.

For placing the cylinders in their proper places in the cavity the introducing pliers are necessary, which have smooth points bent at such an angle as will permit of their being used when closed as a condensing point. See Fig. 428.

The cavity being prepared for the gold and properly protected from moisture, one of the soft cylinders is carried into it with the pliers and placed in such a position that one end rests on the bottom and the other protrudes from the orifice. Pressure in the direction of the wall against which the cylinder rests is then made with the closed points of the pliers, and afterward with a condensing instrument having either a smooth, wedge-shaped point, or, with what is better, a serrated point. When the first cylinder introduced has been well condensed against one of the walls of the cavity, others are introduced and condensed in succession, until these walls are covered by the soft cylinders. The hard cylinders are then disposed round the cavity in the same manner as the soft ones, until it diminishes so much as to render it necessary to form a cavity in the center of the gold already introduced, by means of a smooth, wedge-shaped instrument, such as is represented in Fig. 432. The cavity formed by this instrument is then filled with a small, dense cylinder, and successive openings are thus made and filled until no more gold can be introduced, when the protruding ends of the cylinders are condensed by pressure applied in the direction of the bottom of the cavity. The surface of the filling is then finished in the manner to be described hereafter. To obtain an extremely dense surface, crystal or sponge gold may be added to the surface of a cylinder filling, before such a surface is condensed, by introducing it into the interstices between the cylinders projecting above the margin of the cavity and then applying mallet force.

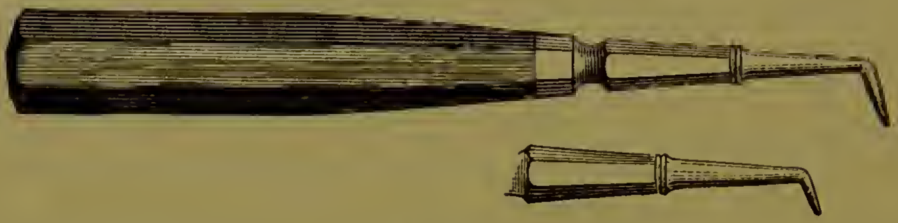


FIG. 432.

When the cavity is of considerable depth and small in diameter, or the bottom is uneven, pellets of gold may be introduced and condensed upon the bottom until the cavity is about one-third filled. By this method the gold is better adapted to the bottom of the cavity than by placing the ends of the cylinders upon an uneven surface. The surface-condensing of cylinder fillings should be made with small-pointed condensing instruments, and any opening it is possible to make with them be filled with small, dense cylinders.

The Herbst Method.—Dr. Herbst, of Germany, has recently introduced a method of manipulating a quality of soft or non-cohesive gold, in the form of cylinders, made by Wollrab, of Bremen, to which the name "rotation gold filling" has been given.

Fig. 433 represents the instruments used in the Herbst method, which are smooth, but not polished, and some of the points are quite fine. As these instruments, when made of steel, become coated with gold by its adhesion, they can be cleansed during their use by rubbing their points on a piece of block-tin or upon fine crocus-cloth; it has also been suggested to plate the points with gold. This German gold appears to become cohesive by rubbing it with the instruments, which have points like burnishers and are rotated in the introduction and consolidation of the gold. By slightly annealing the cylinders they can be united, and even hammered, without crumbling in pieces. The cavities into which this form of gold is introduced are prepared in the usual manner, with their edges smooth and slightly rounded off; deep retaining points are unnecessary, and but few pits are required.

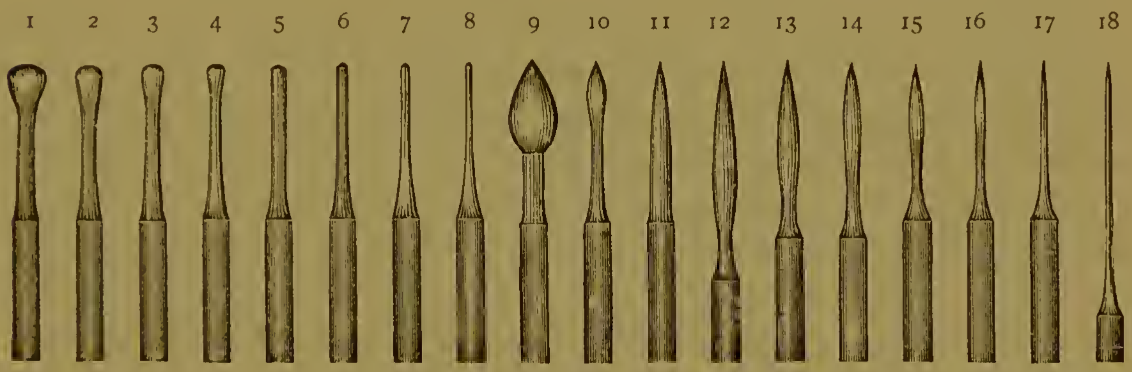


FIG. 433.

For filling an ordinary cavity in a grinding surface, the quantity of gold first introduced should be large enough to be retained when condensed, without support from an instrument, which is accomplished by packing the cavity loosely, but quite full of the cylinders, when the instruments numbered 2, 3, or 4 (Fig. 433), by a slow rotation, burnish the gold against the walls. A second layer of gold is made to adhere to the surface of the first gold introduced, by the use of the form of instrument represented by numbers 5, 6, 7, or 8, by rotating it quickly until the polished surface of the first gold introduced has been destroyed, when the second layer of gold will adhere to it. The filling of the cavity is continued in this manner until all of the gold necessary is introduced and consolidated.

For filling two superior incisor cavities in opposite approximal surfaces, after being prepared in the usual manner, they are treated as one cavity by introducing the gold into both at the same time (bringing over), first securing it in the four corners or angles by rotation with the instruments represented by numbers 5, 6, 7, 8, according to the size required, so that a common mass of gold appears. The fine-pointed instrument, No. 18, is then inserted, with regular rotation, into this mass, between the two teeth, until it is separated, when thin files or discs and tape are employed to finish the surfaces of each filling.

For filling two similar cavities in the approximal surfaces of bicuspids and molars a matrix is used, which is secured in place between the teeth with shellac, one cavity being first filled by commencing the introduction of the gold against the cervical wall or border, and condensing against the matrix at that point, and then toward the center of the crown. The first cavity being filled, the shellac is removed and the remaining cavity filled in the same manner. The rotation and pressure of the instruments appear to produce sufficient heat to render the gold cohesive, and it is claimed that a filling by this method and with this quantity of gold can be inserted very quickly, and that it is impermeable to all fluids.

Pellets.—Another form in which non-cohesive gold foil is used is that of pellets, which are formed by lightly rolling a portion of a sheet between the thumb and fingers. They are made of different sizes, and when placed in a cavity are welded together by means of pointed or serrated instruments. It is necessary that the first pellets introduced should be securely anchored, in order that the successive ones may be built upon them; these last should be small enough to allow the welding instrument to pass through them to the gold beneath.

COHESIVE GOLD FOIL.

Cohesive gold foil is well adapted for 'all shallow cavities and for restoring lost portions of the crowns of teeth. While non-cohesive gold is retained by the general form of the cavity, cohesive gold is anchored by means of retaining points or pits, on the principle of welding one piece or fold to another until the required quantity is introduced. The number of retaining pits will depend upon the form of cavity to be filled, varying from three to six. The depth of these retaining points will also depend upon the strength of the walls of the cavity, as will also, in a great measure, their diameter; as a general rule, a greater number of small pits if the wall is weak, and a few large pits where the wall is strong, or where a portion of the filling has to withstand great force. These retaining pits are made with small, square-edged drills, to a depth corresponding with the diameter of the drill, and in a direction opposite to each other, and in a line with the force to be resisted. Each of these retaining pits is solidly filled with pellets of a suitable size, the pieces of gold being conveyed to the cavity by means of the introducing pliers, and thoroughly condensed by mallet force. The retaining pits being filled, the gold is built over from one to the other, until the surface upon which they are located is covered, which secures a base for the entire filling. Larger pellets are then built upon this base, care being taken to adapt the gold perfectly to the walls of the cavity by gradually building it somewhat higher against the walls than in the center. The operation is continued in this manner until the edge of the cavity is reached, when the gold is built up in the center and above and over the margins, to permit of its being so cut away as to conform to the original contour of the surface which it is to restore.

The cutting away of the surplus gold is accomplished by means of suitable plug-finishing files, or plug-finishing burs, corundum disks or points, Hindostan or Arkansas stone points, etc., after which smoothing process a high polish is given to the entire surface.

In manipulating with cohesive foil, a preliminary step in the operation is to attend to the quality of the gold. It must possess sufficient cohesiveness to cohere under moderate pressure; and as this property deteriorates on the exposure of the foil to the atmosphere, it is often necessary to restore it by the application of heat, as the welding principle, and not mechanical force, is relied upon. To accomplish this, the gold, either in the sheet, ribbon, or pellet form, is subjected to the flame of an alcohol lamp until it becomes a bright red.

Fig. 396 represents a gold-foil annealing lamp. A wire-gauze frame is very convenient for re-annealing the entire sheet, and a mica plate or platinum pan for the pieces or pellets. Many prefer to pass the roll and pellets directly through the flame at the moment they are being carried to the cavity with the introducing pliers. Another method is to boil the gold for a few minutes in a solution composed of forty drops of sulphuric acid and two gills of rain-water. This diluted acid removes all extraneous matter from the surface of the gold, which soon dries, and is found to be very cohesive.

There are a number of methods by which this form of gold foil is prepared for introduction into the cavity. One consists in tearing fragments from a sheet, previously annealed, and condensing a single thickness at a time with a fine serrated point. Another method consists in lightly rolling up the whole or part of a sheet in the form of a rope and cutting this up into pellets of different sizes. In forming the pellets, the sheet should be very lightly rolled up between the thumb and fingers, or, what is better, lightly folded by means of a foil folder, and chamois skin. It may also be folded within the leaves of the book containing it, into two, three, four, or more ribbons, according to the size of the cavity to be filled, and then cut with the scissors.

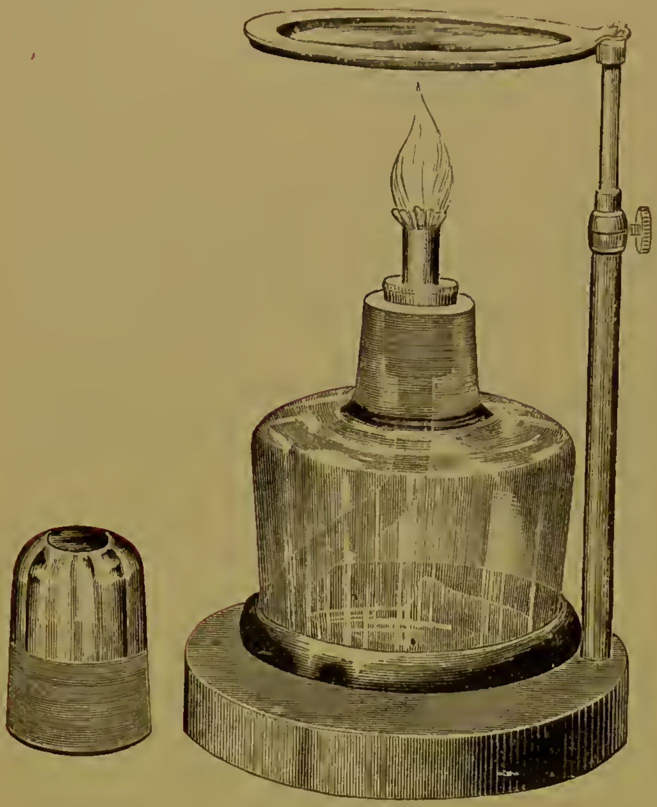


FIG. 434.

Some, instead of forming pellets, prefer to introduce this quality of gold in a long rope, or, better still, a ribbon containing from one-tenth to one-half sheet of No. 4 foil, which is annealed by holding it in the center with the pliers and rapidly passing it through the flame. When the gold is ready to introduce and the cavity is carefully dried and protected against moisture—absolute dryness being very essential in the use of all the cohesive forms of gold—the first pellet, or the end of the rope or ribbon, when such forms are used, is carried from the flame to a retaining point in the cavity, where it is securely anchored by being thoroughly consolidated by means of instruments having fine serrated points. As soon as the retaining points are solidly filled, the gold is built up from these over the bottom and sides of the cavity, care being taken to condense it well against the walls as it approaches the orifice. Every pellet or fold must be consolidated as it is introduced, and the gold built up higher against the *walls* of the cavity than in the center, until the orifice is reached, when the depression left in the center can be filled up. Very lightly rolled or folded gold should be applied to the walls of the cavity, else it may clog, and cannot be consolidated to such a degree as is necessary to give solidity to the filling. It is beyond question that to the introduction of the rubber dam is due the splendid achievements with cohesive gold of the present time, as it is absolutely necessary that such gold, during its manipulation, should be kept perfectly dry. The rubber dam has, therefore, become an indispensable aid in all manipulations with gold as a filling material. Should moisture interfere with the introduction of gold in filling a tooth, it is far preferable to remove all that has been introduced and commence anew than to depend upon any attempt to dry the surface by means of heated air from the hot-air syringe.

Figs. 423, 425, 426 and 427 (pages 486, 487 and 488) represent the forms of instruments for introducing and consolidating cohesive gold foil.

Heavy Foil.—A number of years ago attention was directed by Dr. Robert Arthur to the use of the heavy numbers of gold foil for filling teeth; and later the interest in this form of gold revived to such a degree that very many advocated its claims.

Nos. 15, 20, 30, 60, 120, and even higher numbers have been used. Nos. 15 and 20 can be consolidated by hand force, if such is desired, while the heavier numbers require mallet force. The method of manipulating this foil is to cut it—without allowing it to come in contact with the fingers—into pieces varying from one-fourth to three-fourths of an inch square, or into strips of a proper width and length to suit the cavity to be filled. The gold is then annealed by heating each piece or strip, held by the pliers in the flame of an alcohol lamp, to a red heat. For filling the front teeth the strip is preferable, condensing each layer across the entire surface of the cavity and folding the strip upon itself. Retaining points are solidly filled and the gold built from one to the other, presenting as uniform a surface as possible, and not allowing the foil to become crumpled or folded irregularly upon itself. For filling the posterior teeth the small pieces are preferable, introduced, like the strip, with the pliers, and each one thoroughly consolidated. The gold should be

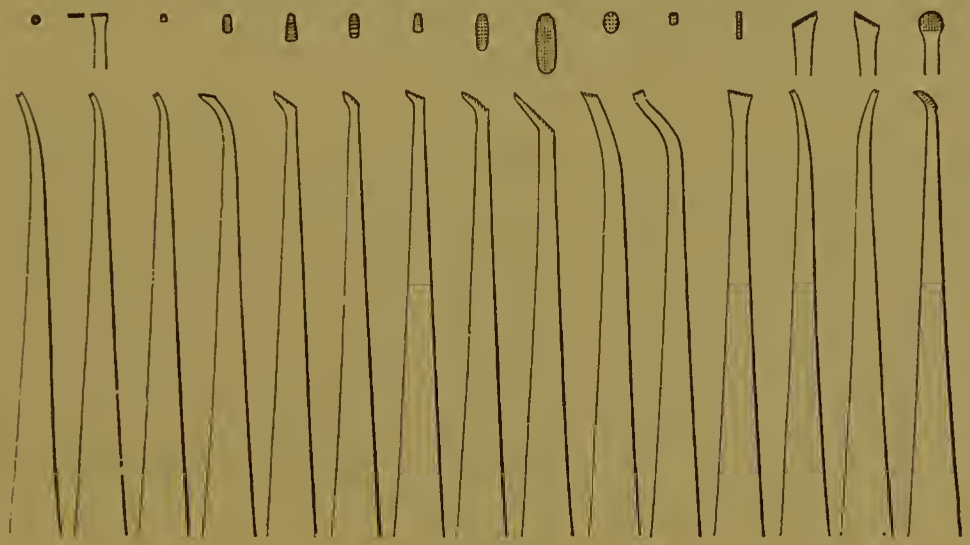


FIG. 435.

carefully condensed at and over the margins of the cavity, layer by layer.

The manufacture of these heavy foils by rolling instead of beating is said to render them softer and more cohesive; but, in the editor's opinion, this form of gold offers no advantages over the lighter numbers, such as No. 4. On the contrary, it is decidedly more difficult of manipulation and far less easily adapted to the walls of the cavity. Some have found it useful for finishing out the surfaces of large fillings.

Fig. 435 represents a set of Dr. C. R. Butler's instruments for manipulating the heavy foils with mallet force.

CRYSTAL OR SPONGE GOLD.

In the use of crystal or sponge gold a different method of procedure is required from that employed with foil.

The chief difference between the instruments employed for introducing and consolidating crystal gold in the cavity of a tooth and those used for gold foil, consists mainly in having the working extremity blunt, varying in diameter from a line to almost a mere point, with shallow serrations upon the surface.

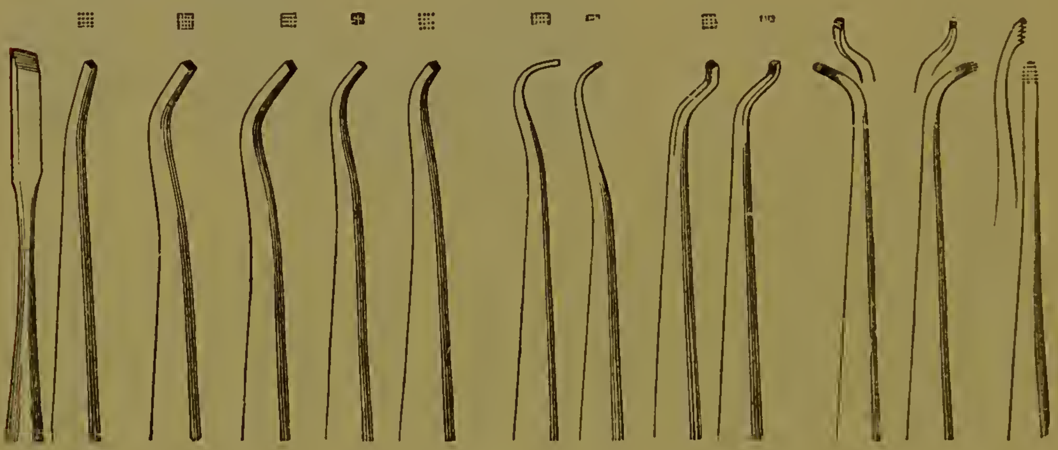


FIG. 436.

Fig. 436 represents a set of instruments well adapted for the manipulation of crystal gold.

In filling teeth with crystal gold the cavity is prepared in the same manner as when leaf gold is employed. This done, the gold is cut, or rather torn, from the block with the point of an instrument, into small pieces, varying in size according to the dimensions of the cavity and the particular stage of the operation in which it is to be used. It being important that the crystals or particles composing the mass should be as little separated or displaced as possible before the piece is carried to its place in the tooth, this form of gold should be used in pellets as large as can be introduced into the cavity without crumbling. The gold being divided into pieces of the proper size, the cavity is washed, and then wiped dry with prepared cotton, or flax and bibulous paper; a piece of gold, as large as the orifice of the cavity will receive, is taken up with suitable pliers or one of the sharp-pointed instruments, as may be most convenient.

The spongy mass readily adheres to the serrated surface of the working extremity when pressed gently upon it, and with this it may, in most cases, be carried to the bottom of the cavity. Every part must now be thoroughly consolidated, first with a large, and next with a smaller, and lastly with a very delicately-pointed instrument, so bent that it may be readily applied to all the depressions and inequalities of the walls and floor of the cavity; for unless the fold is made absolutely solid in these places, as well as throughout all the parts of the filling, the success of the operation will be more or less uncertain. Thus, piece after piece is applied, consolidating each one as the operation progresses, until the gold protrudes sufficiently from the orifice of the cavity to admit of a good finish, leaving the surface flush with that of the tooth.

If, during any part of the operation, the smaller-pointed instruments can be forced between the gold and the walls of the cavity, such opening or openings should be filled with smaller masses of the material before another large piece is introduced. This precaution ought never to be neglected; for should any soft places exist after the completion of the operation, the filling will be apt to absorb moisture, and ultimately to crumble and come out. It is also indispensably necessary that the gold, during its introduction into the tooth, be kept absolutely free from moisture, as this destroys the cohesive or welding property of the crystals.

The gold having been introduced and consolidated as directed, the exposed surface is scraped or filed down to a level with the orifice of the cavity, then made smooth by rubbing it with Arkansas stone or with finely-powdered pumice, and burnished or polished with crocus, in the manner as described when gold foil is used.

In finishing a filling made with these preparations of gold the operator should see that there are no thin, overlapping portions upon the teeth outside of the orifice of the cavity. They are liable, in biting hard substances or in ordinary mastication, to be broken off, leaving a depression for the lodgment of extraneous matter and clammy secretions. Sooner or later this will give rise to a softening of the dentine thus exposed, which, if it does not cause the filling to loosen, will ultimately render its removal and replacement necessary. In short, the precautions necessary to be observed in making a filling with gold foil are equally necessary when the operation is made with either of the preparations now under consideration.

Mallet Force in Consolidating Gold.—A number of years ago Dr. W. H. Atkinson introduced a method of consolidating gold by means of mallet force, which has now become a favorite one with many of the best operators in the profession. He claimed for this method the following advantages over hand pressure: A more perfect condensation of the gold and a more thorough welding than can be made by hand pressure; that the gold will be anchored in its position with much more facility; that the instrument always acts under the mallet upon the designed point, does not slip from its position, and, consequently, there is no liability of abrading or wounding the soft parts; that mallet force is not more unpleasant to the patient than the ordinary method of condensing, and that it is far less fatiguing than hand pressure in protracted operations.

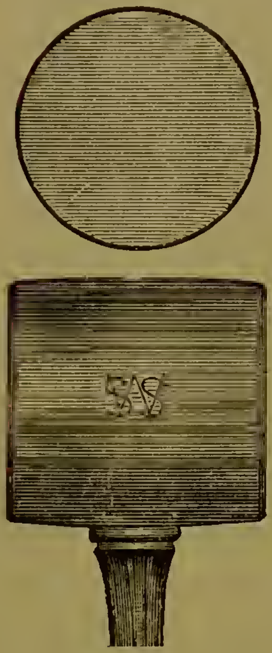


FIG. 437.

That mallet force is an effective method of condensing the cohesive forms of gold there can be no question.

Mallets of almost every description have been used, such as wood, lead, tin, copper, brass, steel, ivory, and vulcanized rubber.

The steel mallet, however, is considered by many to produce the best results, while the lead mallet gives a dead blow and may be more agreeable to the patient.

Heavy lead and tin mallets, weighing from four and a half to six and a half and even eight ounces, are preferred by many of the advocates of the hand mallet.

In using the hand mallet, which is represented in Fig. 437, the aid of an assistant is necessary, who taps the end of the plugger squarely with sharp, springing strokes, while the principal operator directs its condensing point over the gold as it is introduced into the cavity.

With instruments called automatic mallet pluggers—Figs. 438 and 439 represent Snow and Lewis's, Fig. 440 Abbott's—the aid of an assistant is unnecessary.

All of these forms operate by the action of a spiral spring, and some of them have a back action.

Automatic pluggers for use with the dental engine are also employed for the condensation of gold in filling teeth.

Fig. 441 represents an engine mallet invented by Dr. W. G. A. Bonwill, having his hand-piece attached. This engine mallet gives a very

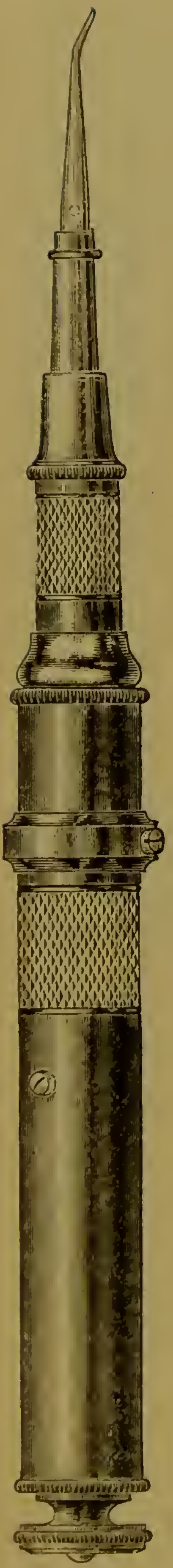


FIG. 438.

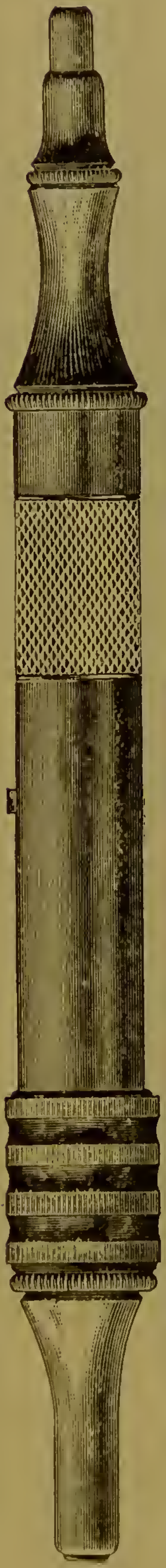


FIG. 439.—Double Action.

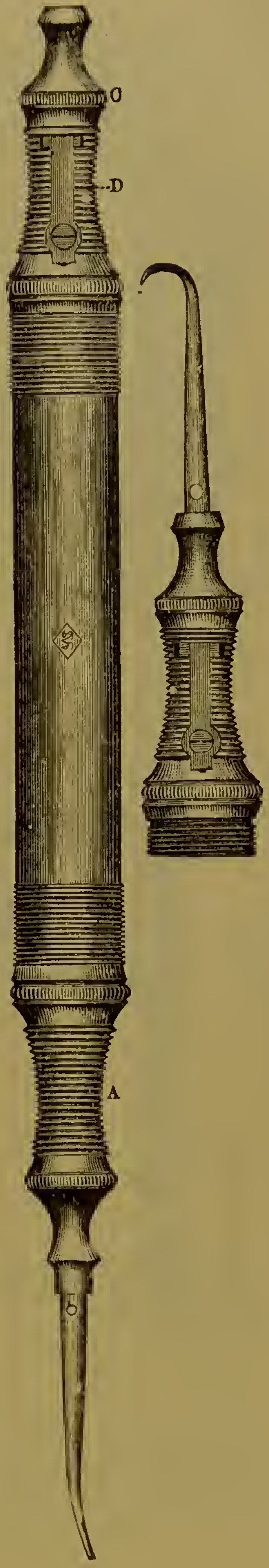


FIG. 440.

satisfactory blow, and requires but little foot power, and can be worked by either foot and on either side of the chair.

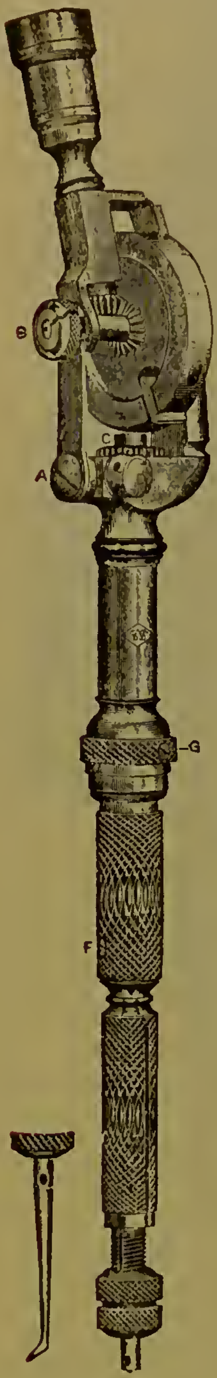


FIG. 441.

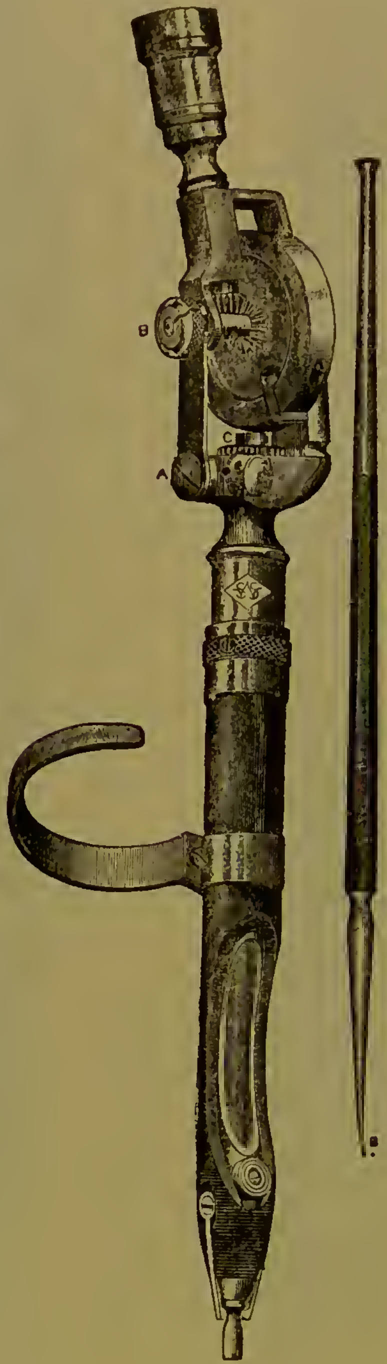


FIG. 442.

Fig. 442 represents the electro-magnetic mallet invented by Dr. W. G. A. Bonwill, which is used by many of the most skillful operators. The blow is delivered upon the packing instrument, just at the point where its force is greatest, as the attraction of the magnets constantly increases as the mallet approaches them until the circuit is broken. By combining the stem and holder of the Electric Mallet with the striking mechanism of the Mechanical Mallet No. 1, an appliance is formed in which the operator can use effectively the long-handle pluggers made for the electric mallet. Ordinary socket-points can also be used in it with equal facility by means of the proper socket-handles.

Fig. 443 represents a set of instruments devised by the late Dr. Marshall H. Webb, for use with the electro-magnetic mallet.

Finishing the Surface of the Filling.—After having thoroughly consolidated the surface of the filling, finishing files, such as are represented in Fig. 444, are used to remove the protruding portions of gold and to form a smooth, uniform surface, free from the slightest indentations which may afford lodgment to extraneous matter. This is a point never to be lost sight of; for, however excellent the filling may be in

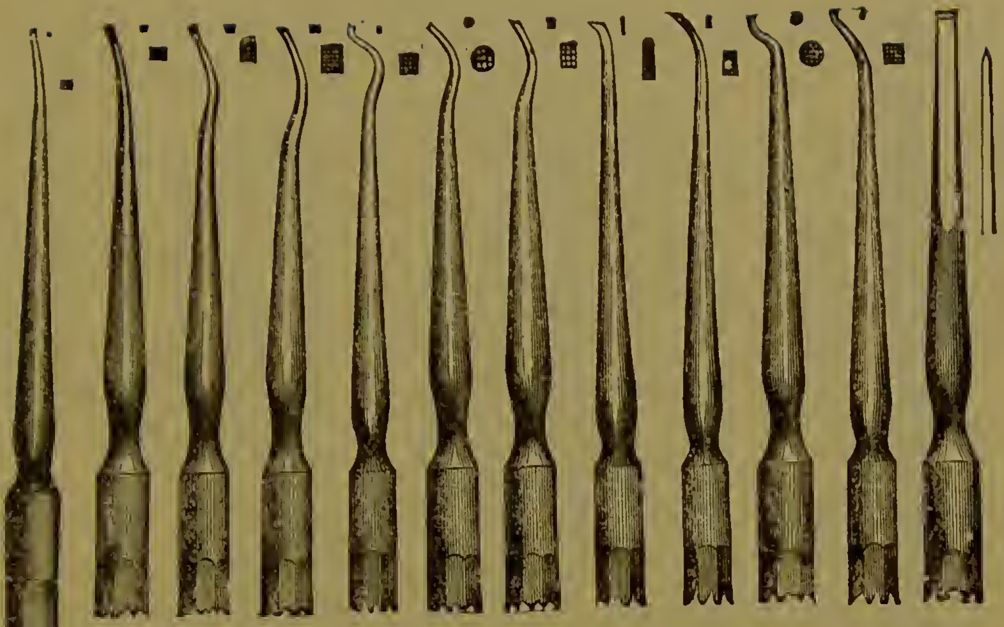


FIG. 443.

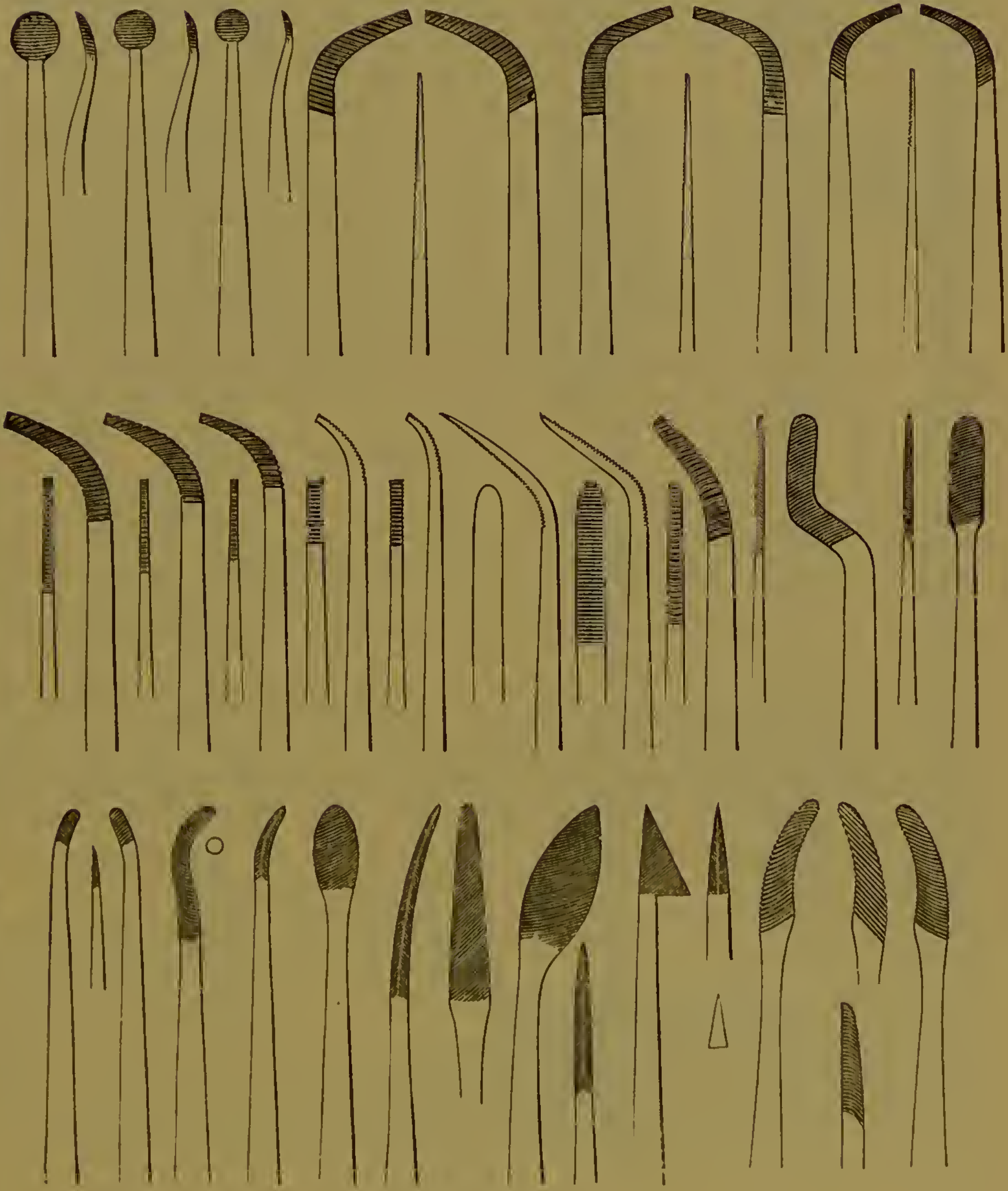


FIG. 444.

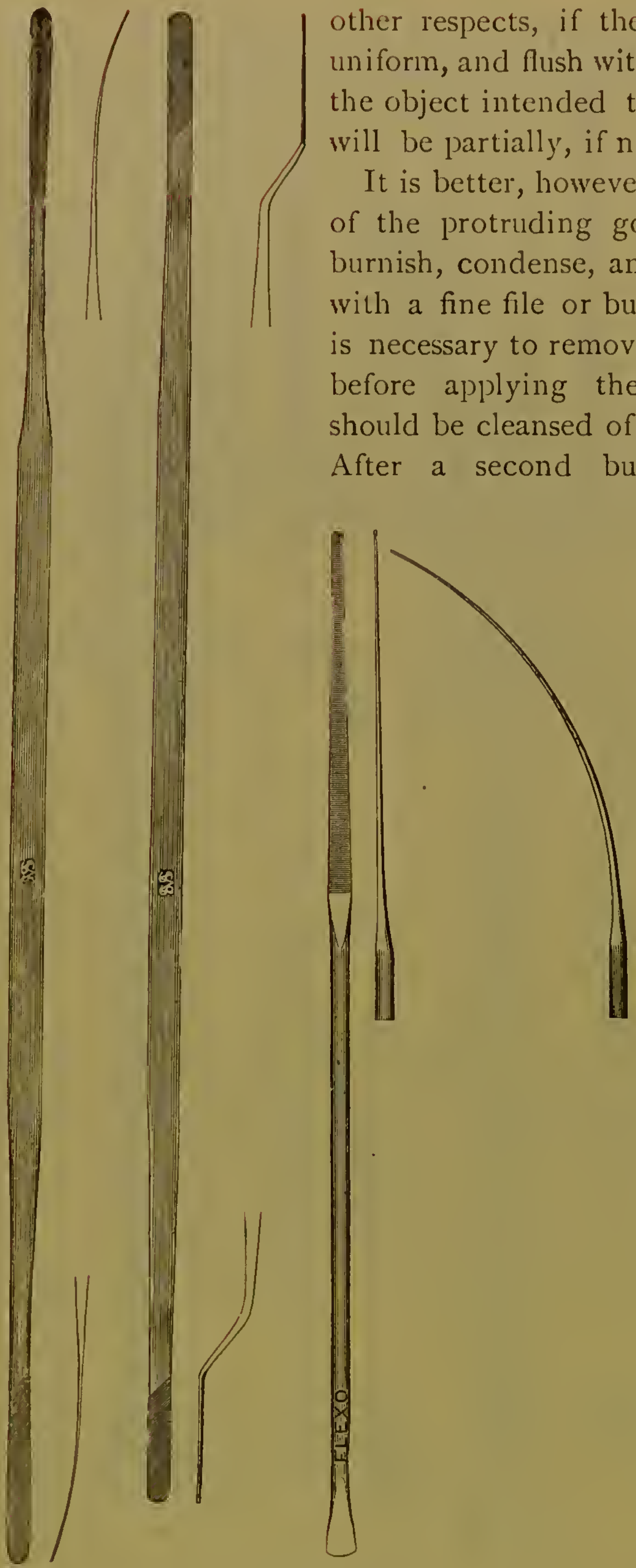


FIG. 445.

other respects, if the surface is not smooth, uniform, and flush with the orifice of the cavity, the object intended to be accomplished by it will be partially, if not wholly, defeated.

It is better, however, to cut off but a portion of the protruding gold at first, and then to burnish, condense, and to cut a second time, with a fine file or bur or an emery strip, all it is necessary to remove. After each filing, and before applying the burnisher, the surface should be cleansed of all loose pieces of gold. After a second burnishing, the Arkansas, Hindostan, or Scotch stone, or finely-powdered pumice, may be applied to the surface, to remove all the file scratches and other asperities. For a filling in the approximal surface of a tooth the stone may be shaped like a pinion file; it should be frequently dipped in water, and when its pores become filled with gold the surface may be ground off by rubbing it on a corundum slab. If the filling is finished with pumice, it may be applied with floss silk or tape moistened with water, by drawing it backward and forward across the surface of the filling.

Fig. 445 represents plug-finishing files, for finishing contour compound gold operations in the approximal surfaces of teeth. With them the gold can be so finished as to restore the natural contour, thereby preventing the surfaces of the teeth from assuming an unnatural contact.

Fig. 446 represents different forms of plug-finishing burs for use with the dental engine.

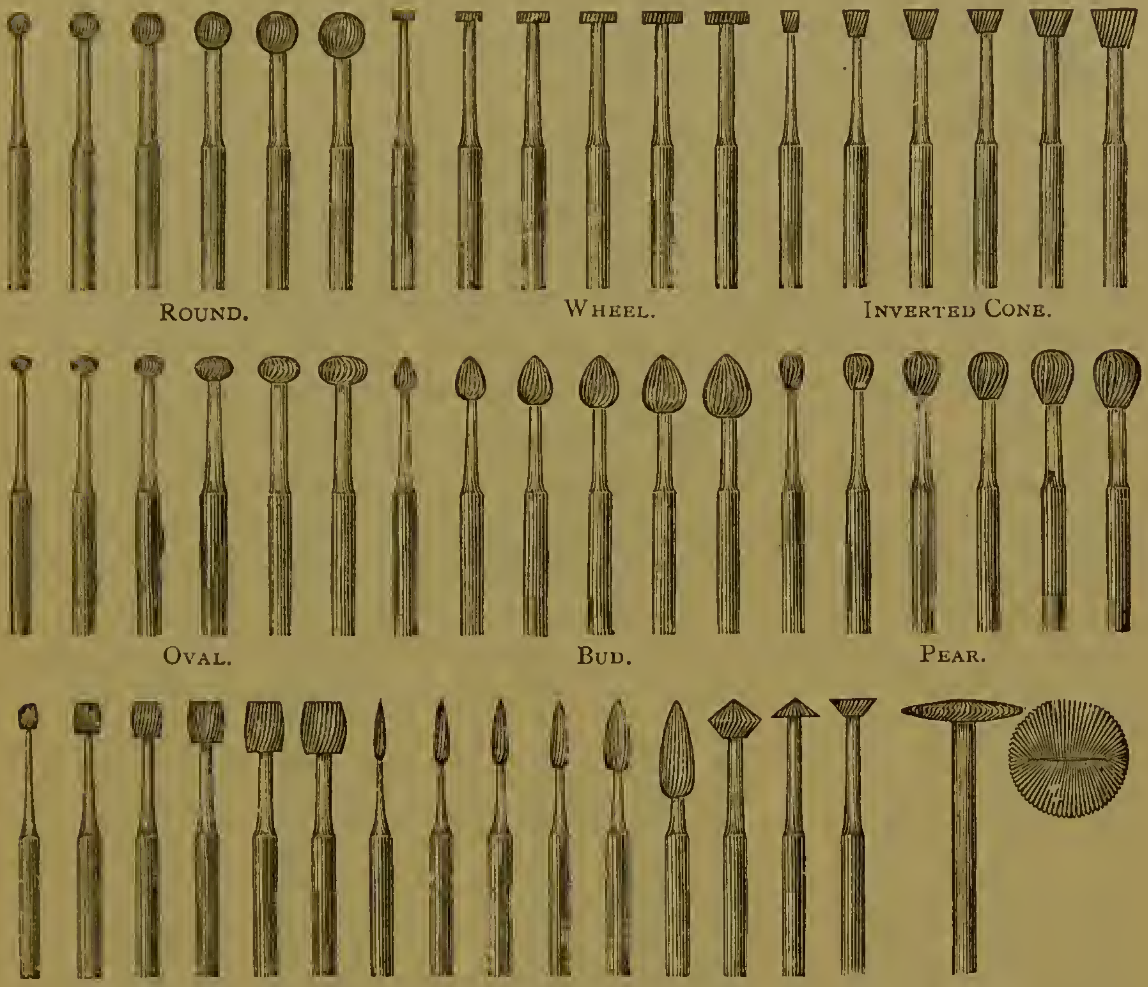


FIG. 446.

Fig. 447 represents an excellent file-carrier, contrived by Dr. Forbes, for files for finishing fillings on the approximal surfaces of the front teeth, and Fig. 448 a tape-carrier.

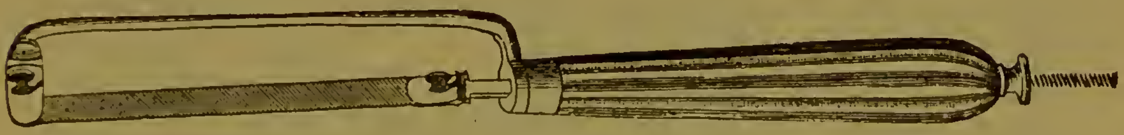


FIG. 447.

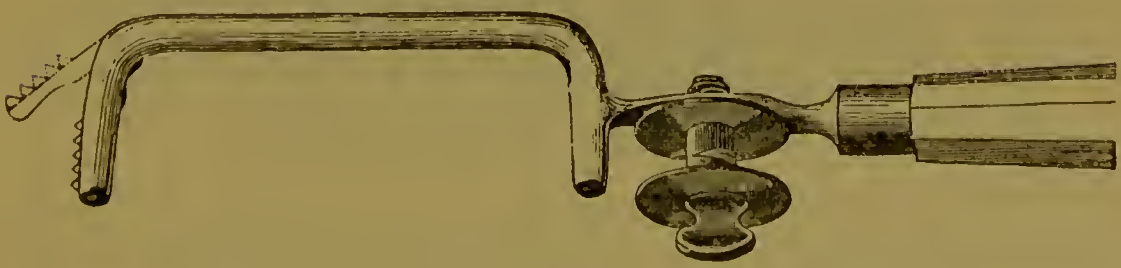


FIG. 448.

Fig. 449 represents a small split tape arbor for carrying a short piece of polishing tape (Fig. 449 *a*), which by the turning of the bit in the hand-piece is rolled on to the arbor and becomes a small polishing-point that will reach fissures and depressions between cusps to finish fillings or gold contour work in a quick and superior manner. Fig. 449 *b* shows the small size of the polishing point thus obtained, but by rolling on a longer piece of tape a correspondingly larger point will be made. Sand-paper discs are also useful.

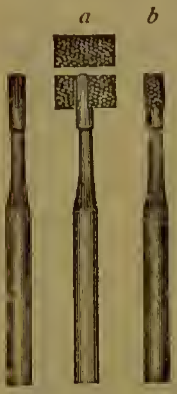


FIG. 449.

If the filling is in the grinding, buccal, or palatine surface of a molar or bicuspid, a long piece of stone, having a small, triangular, and slightly oval point, may be used; if powdered pumice-stone be employed, it may be used on the point of a similarly-shaped piece of soft wood, previously softened in water. After all the asperities have been cut down, the surface should be washed until every particle of grit is removed.

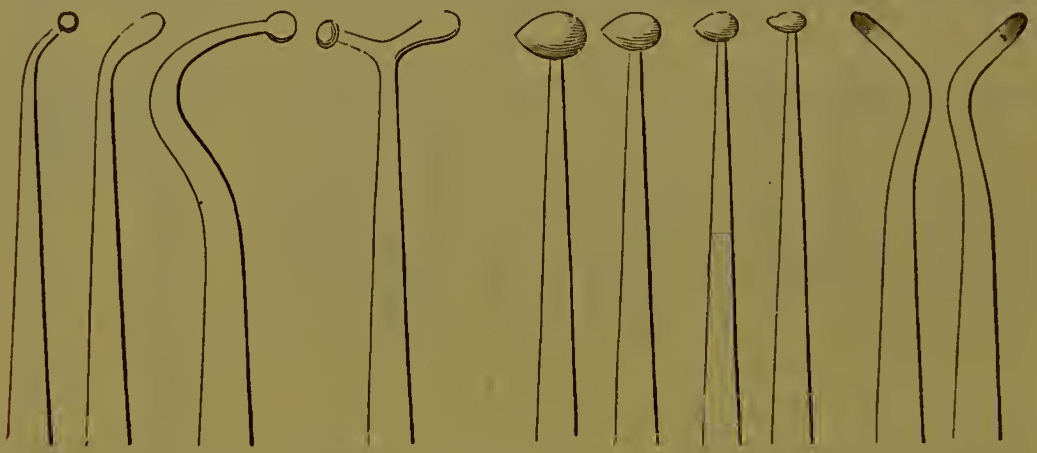


FIG. 450.

This done, it may be polished with a suitable burnisher, dipped from time to time in a solution of pure Castile soap, until the filling is rendered as brilliant as a mirror. Fig. 450 represents various forms of burnishers.

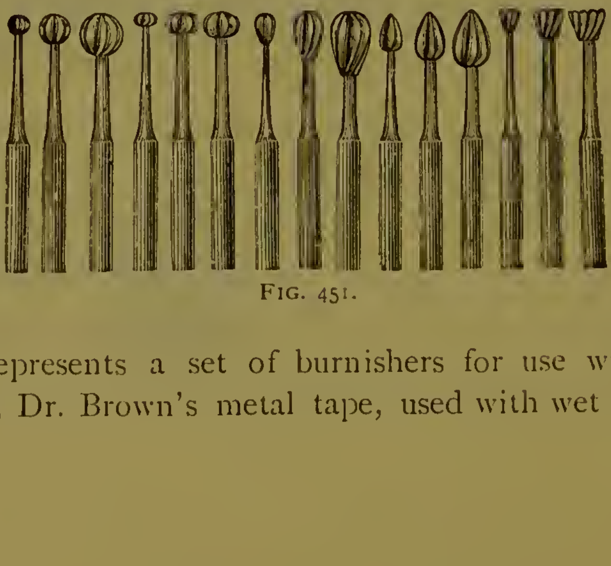


FIG. 451.

Fig. 451 represents a set of burnishers for use with the dental engine. Also, Dr. Brown's metal tape, used with wet polishing-powder, will be found very effective, especially in spaces too small for the entrance of silk (Fig. 452).

Various instruments are used in the process of finishing the surface of metallic fillings, such as coarse and fine burs, corundum points, wood points, emery strips, sand-paper discs, all rotated by the dental engine.

Fig. 453 represents finishing strips with crimped finger-holds, for proximate surface-fillings.

Fig. 454 represents Dr. J. W. Smith's mandrels for carrying paper, felt, or rubber discs.

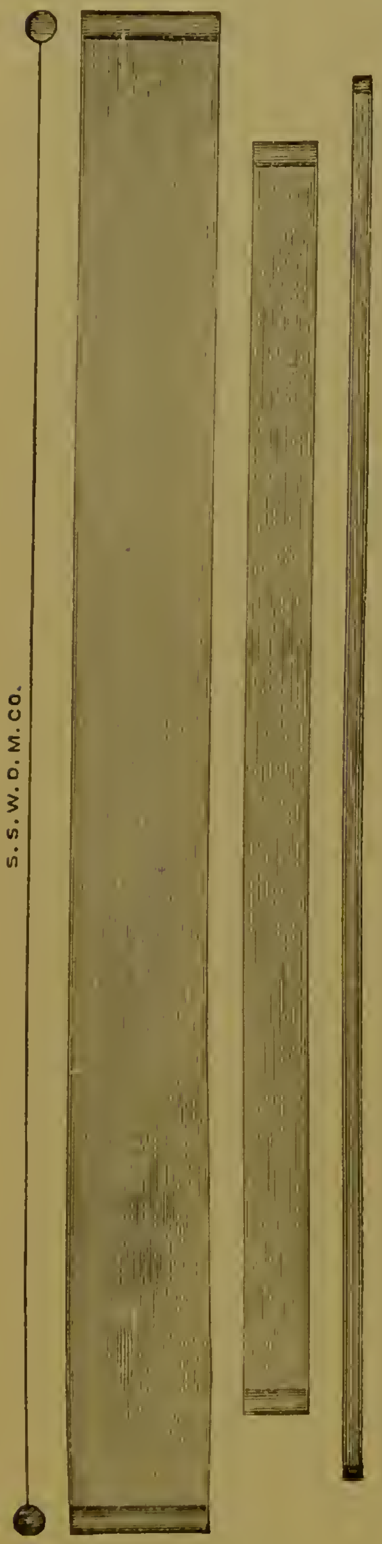


FIG. 452.

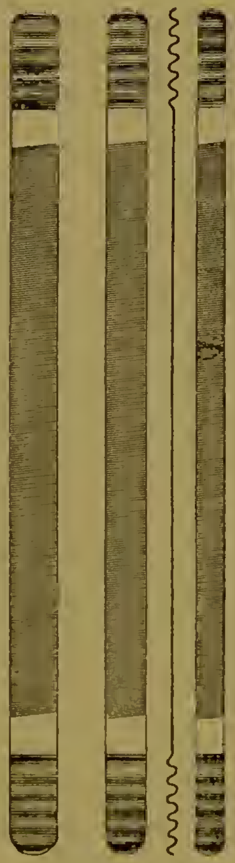


FIG. 453.

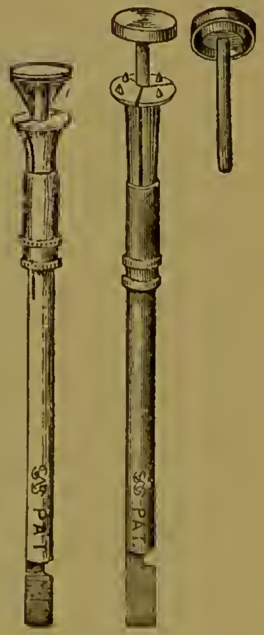


FIG. 454.

Having proceeded thus far, the surface may be again washed and the operation completed by rubbing it from three to six minutes with dry floss silk. Rouge or rotten stone applied to the surface on tape, or finely-powdered silex or pumice-stone on a piece of orange-wood after it is prepared by the method just described, will remove the bright metallic lustre—when this is objectionable on account of the exposure of the filling—

and leave a fine finish. Holly strips in the form of thin shavings answer admirably for applying levigated pumice, rouge, etc., in the polishing process.

Non-Conductors.—When the caries has penetrated nearly to the pulp cavity, the presence of a gold or any other metallic filling is sometimes productive of considerable pain and irritation, especially when hot or cold fluids are taken into the mouth or during the inspiration of cold air. In some cases inflammation and suppuration of the pulp supervene. To prevent these disagreeable results a variety of means have been proposed. Dr. Solyman Brown recommended placing asbestos, this being a non-conductor of caloric, on the bottom of the cavity previously to the introduction of the gold. The author prefers chloro-percha, which may be used in the form of a thick solution, or a layer of thin gutta-percha may be placed at once in the bottom of the cavity. When the solution is used a drop may be placed in the cavity, and a sufficient time allowed for the chloroform to evaporate before introducing the filling. A thin layer of "Hill's stopping," of which gutta-percha forms the principal ingredient, may be used with equal advantage. Oxychlorids and oxyphosphates of zinc have also been used for the same purpose, but the latter are less irritating than the former, and neither possesses any advantages over gutta-percha.

The time required by an expert operator to fill a tooth well may be said to vary from thirty minutes to two hours and a half, or even longer, according to the size, shape, and situation of the cavity, and in some cases a much longer time will be required. Less time and skill are usually required to fill a cavity in the grinding than in the approximal surface of a tooth; but the operation in either place, to be beneficial to the patient, must be performed in the most thorough manner. The dentist who does not feel the importance of making all his operations as perfect as possible should never be intrusted with the management of these important organs. Want of attention to two points in the consolidation of a filling often causes the ultimate failure of operations in all other respects well performed. First, by not making sufficient *lateral* compression whilst introducing the gold the surface is apt to be more solid than the interior. Consequently the filling may drop out for want of a firm contact against the sides; or, if retained, it is apt on grinding surfaces to be pressed inward, leaving a space around the orifice for the penetration of fluids. Second, want of care in condensing around the edges of the filling will, by the crumbling away or scaling off of portions of the gold, expose the edges of the cavity to decay.

In every part of the operation the dentist should so guard his instruments as to prevent them from slipping, which he will usually be better able to do by standing a little to the right and behind his patient than in any other position. In filling the lower teeth he should stand several inches higher than while filling the upper, and for this purpose he should have a stool or movable platform on which to stand. When it can be done, he should grasp the tooth with the thumb and forefinger of his left hand, not only to prevent it from being moved by the pressure he applies, but also to catch the point of the instrument in case it should slip; if he is always careful to press in a direction toward the orifice of the cavity this need not happen; nevertheless, he should always take the precaution to guard against possible accident. When he cannot shield the mouth with the thumb and finger of his left hand, he should let the thumb or one of the fingers of his right rest either upon the tooth he is operating on or upon some other.

For the special application and modification of these general directions the reader is referred to the filling of individual cavities in teeth.

FILLING INDIVIDUAL CAVITIES IN TEETH.

To describe the method of filling each individual cavity in every locality in which a tooth is liable to be attacked by caries would be unnecessarily tedious. But as this is one of the most important and, at the same time, one of the most difficult operations in dental surgery, it may be well to enter a little more into detail upon the subject than we have as yet done. In doing this the writer will confine himself, for the most part, to the manner of filling a cavity in each of the following localities, which are the parts of teeth most liable to caries.

First. In the approximal and labial surfaces of the superior incisors, and cuspids and the palatine surfaces of the incisors, the anterior surfaces of the cuspids and the posterior surfaces of cuspids and incisors being rarely attacked by caries.

Second. In the grinding, approximal, buccal, and palatine surfaces of the molars and bicuspids of the upper jaw.

Third. In the approximal surfaces of the inferior incisors and cuspids.

Fourth. In the grinding, approximal, and buccal surfaces of the molars and bicuspids of the lower jaw.

Other parts of the teeth sometimes become the seat of caries, but the foregoing are the localities most liable to be attacked by the disease.

FILLING THE SUPERIOR INCISORS AND CUSPIDS.

I. *With Non-cohesive Gold Foil.*—In describing the manner of introducing a filling in one of the first-named teeth, we shall commence with the right approximal surface of the left central incisor.

The directions we propose giving for the performance of the operation here will be applicable, with a few exceptions, to the same surface on all the upper incisors. As a general rule, the gold should be introduced from behind the teeth forward and upward, and for the following reasons: 1. When the aperture between the teeth has been formed with a cutting instrument it should, when circumstances of the case will permit, and for reasons stated in another place, be made wider behind than before; consequently the diseased part can be most easily approached from this direction. 2. The gold, in the majority of cases, can be more conveniently introduced from the palatine side, and the force required for condensing it can be more advantageously applied.

The exceptions to the above rule are when the approximal side of the tooth is turned slightly forward toward the lip, and when the caries is situated nearer the labial than the palatine angle; also, when the teeth, instead of occupying a vertical position in the alveolar border, or projecting slightly, as they usually do, incline backward toward the roof of the mouth. It sometimes happens, too, when they are separated by pressure, that the diseased part can be most conveniently reached from the front surface.

The instrument which the author has found best adapted for the introduction of the gold into a cavity in the right approximal surface of an incisor or cuspid tooth is represented in Fig. 455. The width and length, as well as the curvature or angle of the point, should vary according to the size of the cavity and the width of the space between the teeth.

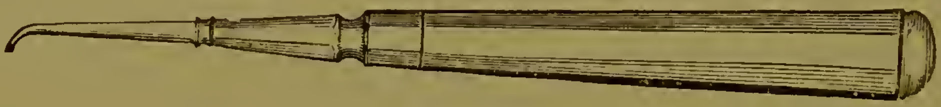


FIG. 455.

The stem of the instrument, as well as the shank, should be strong enough to sustain any amount of pressure which it may be necessary to apply in forcing the folds of gold tightly against each other. The point should be wedge shape and the extremity serrated.

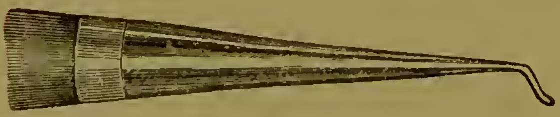


FIG. 456.

The decay having been removed, the cavity, properly shaped, cleansed, dried, and protected, is ready for the reception of the gold. The patient should be seated in a chair sufficiently high to bring the head on a level with the breast of the operator and resting on the head-piece of the chair, with the face upward. The operator, standing upon the right side, should support the patient's head firmly with his left arm during the operation, while with the forefinger of the same hand the upper lip is held out of the way. The middle finger of the same hand ought to rest on the end of a tooth to the left of the one on which the operation is being performed, while with the little finger the lower lip may be gently depressed. The roll or strip of gold is first introduced with the foil pliers.

During the introduction of the gold the instrument should be held in the right hand of the operator (Fig. 457), and grasped with sufficient firmness to prevent it from slipping or rotating.

In introducing the gold the first fold should be applied against the upper wall of the cavity, that the pressure may always be exerted in a direction toward the extremity of the root, applying each additional fold as closely to the preceding one as possible. The folds should also, in their introduction, be applied as closely to the labial and palatine walls of the cavity as possible, but always directing the pressure, when these are thin and brittle, in the direction of the axis of the root.

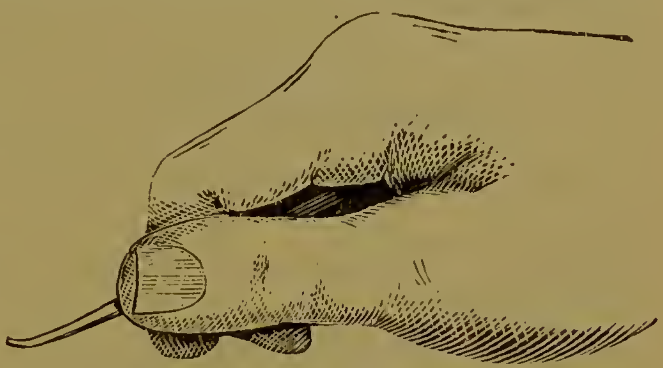


FIG. 457.

When the lower part of the cavity is very narrow, as is often the case, especially where it extends nearly to the labial angle of the tooth, it is often necessary to change the instrument for one having a smaller point.

To carry a fold of gold to the bottom of a cavity upon the point of the instrument, without breaking or cutting it, requires some tact. The point should never be carried directly toward the bottom; on entering the orifice, it should be inclined toward the wall of the cavity opposite the one against which the folds are first laid. Equally as much tact is required to prevent displacing the gold before a sufficient quantity has been introduced to procure support for it from the surrounding walls, which is an accident particularly apt to occur with young practitioners, when the cavity is superficial and has a large orifice. To prevent this, the folds of gold should be long enough to project some distance from the orifice, that they may receive support from the adjoining tooth, and from the thumb and forefinger of the left hand of the operator, until the operation has reached that stage when sufficient stability shall have been obtained from the walls of the cavity.

There are cases in which an instrument like the one represented in Fig. 458 can be very advantageously employed in the introduction of the gold; but in the majority of cases the instrument represented in Fig. 455 will be found more convenient.

After having filled the cavity so thoroughly that a small wedge-pointed instrument cannot be made to penetrate the gold at any point, the extruding portion of the filling should be consolidated, beginning with the portions overlapping the lower part of the tooth and the edge of the posterior wall. These should be carefully and firmly pressed toward the cavity with an instrument having a flat point, like the one represented in Fig. 459. This done, it may be firmly applied to every part of the surface of the filling, continuing the pressure as long as the point of the instrument can be made to indent the gold.

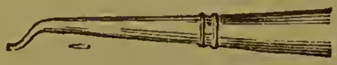


FIG. 458.

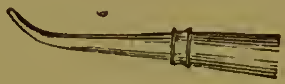


FIG. 459.

When the space between the teeth is very narrow, an instrument shaped as in Fig. 460 may be used. The operator should be provided with two or three instruments like each of the two last, varying in the size, length, and curvature of their points.

During the process of consolidating the gold, the tooth should be firmly grasped between the thumb and forefinger of the left hand; this prevents it from being pressed too forcibly against the opposite side of the socket, while, at the same time, the end of the forefinger, by being placed above the instrument, assists in directing its point and serves to keep it from slipping. When the labial and palatine walls of the cavity are very thin, great care is necessary to prevent fracturing them in introducing and consolidating the gold. The consolidation should be commenced around the edges, and the pressure applied toward the centre of the cavity.

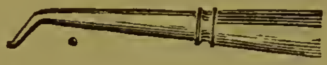


FIG. 460.

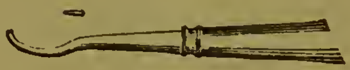


FIG. 461.

It sometimes happens that the caries extends forward to the labial angle of the tooth, and upward, at the same time, under the edge of the gum. Great difficulty is often felt in thoroughly filling this portion of the cavity, and it cannot always be done from behind the tooth. In this case, after having filled the cavity in the manner as already described, the operator may, standing on the left side of the patient, and with an instrument having a wedge-shaped point (Fig.

461), make as large an opening as possible in the gold. This done, he may grasp the left lateral incisor or cuspid tooth with the thumb and middle finger of his left hand, elevating the upper lip with the forefinger of the same; then, with the instrument held as in Fig. 462, he may proceed to introduce the gold, filling the upper part of the opening first. After introducing fold after fold, until the cavity is completely and compactly filled, the extruding portion should be consolidated with a similarly-shaped instrument, having a flat, serrated point, this style of point being preferable to the round point for introducing and consolidating non-cohesive gold.

The size of the roll of gold must be varied to suit the size of the cavity, though it should seldom have in it more than a fourth of a leaf of No. 4. If more than this is employed at one time, it will be difficult to apply the folds sufficiently near each other.

The method of filling the right central incisor in the left approximal surface is so very similar to that of filling the left in the right side that it will not be necessary to enter so minutely into detail. In this, as in the other case, the gold, as a general rule, should be introduced from behind the tooth, forward and upward; but if introduced from the front, the operator should still stand on the right side of the patient. The head should have the same elevation and inclination backward but the face should be turned more toward the operator, to give him a better view of the cavity in the tooth, and to enable him to reach it more readily with the instrument.

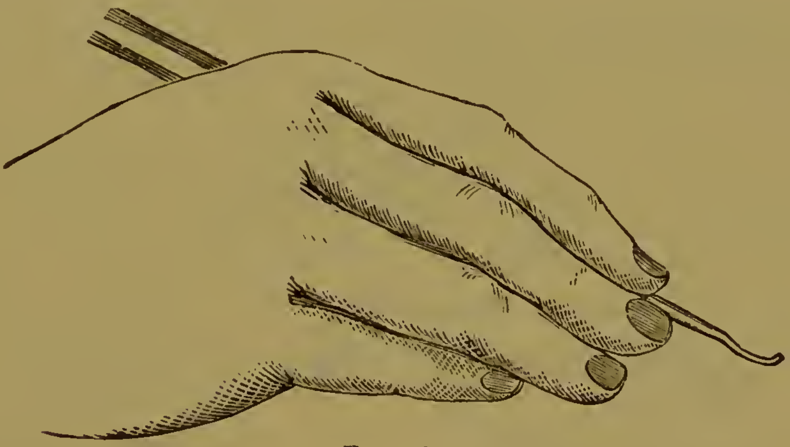


Fig. 462.

The cavity being formed, cleansed, and dried, the operator may proceed to introduce the gold as already directed, with an instrument like the one represented in Fig. 455. In many cases, however, he will require one having a somewhat longer point, and curved at nearly a right angle with the stem. The instrument should be held somewhat differently in the hand (Fig. 463), and grasped firmly with the thumb and fore and middle finger, so as to prevent it from rotating.

The head should be securely confined with the left arm, the upper lip raised with the left thumb, pressing it at the same time firmly against the anterior surface of the tooth. The middle or forefinger of the same hand may be placed against the gum just inside the tooth, to direct the application of the point of the instrument, prevent the liability of its slipping, and control the free end of the roll of foil. The lower lip may be depressed either with the middle joint of this or with one of the other fingers.

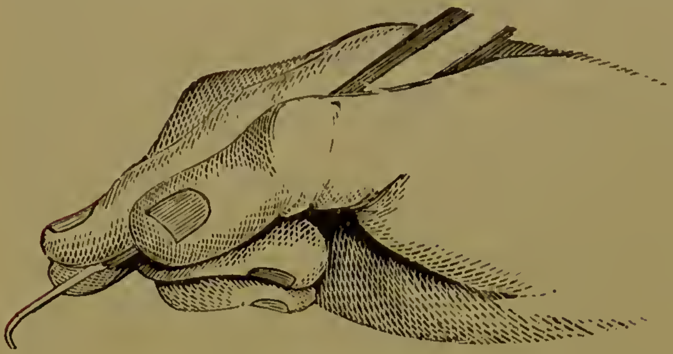


FIG. 463.

After having placed one end of the fold in the cavity, fold after fold should be introduced until it is compactly filled, except in those cases where the lower part is very small, when a smaller-pointed instrument should be employed for the completion of the operation and, indeed, for the introduction of all the gold, if the cavity is not large, or the aperture between the teeth very narrow.

For consolidating the extruding gold, the instrument represented in Fig. 459 will, in many cases, be all that is required. But the one represented in Fig. 464 can sometimes be used very advantageously; and the one in Fig. 465 will be found a useful condenser for the right as well as the left approximal surface of an incisor or cuspid tooth; and both the last mentioned instruments may often be used to great advantage on the approximal surfaces of other teeth. Some of the instruments employed in filling teeth with cohesive and crystal or sponge gold may also be advantageously employed in consolidating the ordinary gold in the approximal surfaces of the incisors and other teeth.

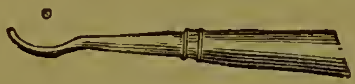


FIG. 464.

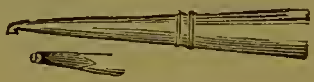


FIG. 465.

In completing the operation, it is important that every particle of gold overlapping the orifice, and frequently extending under the free edge of the gum, should be removed before finishing the surface of the filling; but the operator ought, at the same time, to avoid as much as possible wounding the gum and peridental membrane. As the cavity frequently extends a little above the gum, great care is necessary to prevent wounding it; indeed, there are many cases in which it cannot be avoided, unless the point of the gum is pressed up between the teeth by the introduction of a piece of raw cotton, band of rubber or wedge of wood, or Hill's stopping, a day or two before the operation of filling is performed.

In filling an incisor or cuspid tooth on the labial surface the operation is often very simple and easy, but there are many cases in which it is both difficult and tedious. The head of the patient should rest with the face upward, as already described, and sustained in the same way, with the left arm of the operator, while, with the thumb of the left hand placed on the gum above the tooth, the upper lip should be elevated.

The forefinger should be pressed firmly against the palatine surface of the tooth and the left side of the chin gently grasped with the other three fingers. Then, with an instrument (Fig. 466) having a wedge-shaped point, grasped with the right hand, as in Fig. 463 or 467, the operator should proceed to introduce the gold, standing at the right side of the patient, with the thumb of the right hand resting on a tooth to the left of the one he is about to fill or against the cheek. He should commence by laying the first fold against the walls of the cavity nearest to him, and thus introduce fold after fold, until it is compactly filled. The extruding portion may be consolidated with a round or square-pointed instrument, or with a sharp-pointed one, as represented in Fig. 468. Great care is necessary to prevent the instrumeut from slipping and wounding the gums. After having partially consolidated the gold, the overlapping portion must be firmly pressed toward the centre of the cavity, and the point of the instrument repeatedly applied to every part of the surface of the filling, until it can no longer be made to yield to pressure. This done, the gold may be filed down to the level of the tooth, smoothed with Arkansas stone, and burnished or polished.

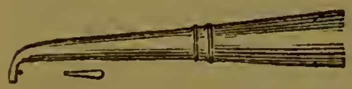


FIG. 466.

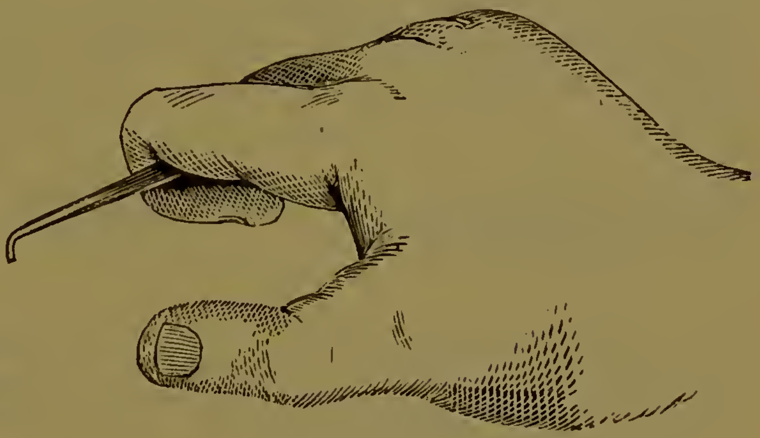


FIG. 467.

When the cavity is shallow and the orifice broad, the gold, as it is introduced, must be held in its place with the thumb of the left hand until a sufficient quantity has been placed in the cavity to obtain for it the necessary support from the surrounding walls. But in overcoming difficulties of this sort, the peculiar circumstances of the case can alone suggest the proper means to be employed by the operator.

The decay sometimes extends entirely across the labial surface of the tooth, leaving after its removal a horizontal groove open at both ends. In this case the walls should be made rough, wider at the bottom than at the opening, and the operation of filling commenced at one end by applying the folds of foil alternately against the upper and lower wall, and consolidating them so thoroughly as to prevent the liability of their being displaced during any subsequent part of the operation. Successive folds are introduced in the same manner, each in close contact with the preceding series, until the groove is completely filled, applying the pressure, during the whole of the operation, against the two walls. In condensing the extruding gold, the operator should commence first at one end of the groove, then at the other, and afterward consolidate the whole surface of the filling. In finishing the operation, the same precaution with regard to wounding the gum and peridental membrane should be observed here as recommended for the approximal surface of the tooth.

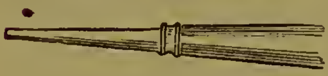


FIG. 468.

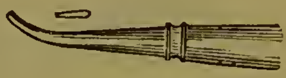


FIG. 469.

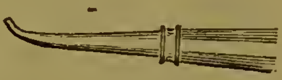


FIG. 470.

Although it rarely happens that the palatine surfaces of the upper incisors are attacked by caries, yet the disease does sometimes develop itself there, in the indentations occasionally found a little below the free edge of the gum. The removal of the diseased part, the formation of a cavity, and the introduction of a filling can, in the majority of cases, be more easily accomplished in this than in any other part of an incisor tooth.

The cavity being properly prepared for filling, the head should be placed as before directed, except that the chin may be a little more elevated, to enable the operator to obtain a more convenient view of the locality of his operation: the thumb of the left hand may be placed on the labial surface of the tooth and the forefinger on the gum immediately above the palatine surface. He should now, with a wedge-pointed instrument, shaped as in Fig. 469, proceed to introduce the gold, applying the first fold against the palatine wall or the palato-approximal angle of the cavity, as may be most convenient. Having filled the cavity, the extruding gold may be condensed with an instrument like the one represented in Fig. 470.

Sometimes straight instruments, and at other times instruments curved at the points more than those represented in Figs. 469 and 470, can be more conveniently employed, depending altogether upon the size of the mouth and the forward or backward deviation of the teeth from a vertical position. This is a matter, therefore, which the judgment of the operator must determine.

II. *With Cohesive Gold Foil.*—For filling cavities in the approximal surfaces of the superior incisors and cuspidati, the most effectual means should be adopted to retain the filling. In some few cases it may not be possible to do more than form small undercuttings at each approximal angle of the cavity, and another similar one at the cutting-edge, which would be sufficient for the retention of a non-cohesive gold filling; but in the majority of cases one of cohesive gold can be so securely anchored that the cervical wall is perfectly protected, and a fracture at any point along the edges of the cavity will not dislodge the filling.

To effect this, retaining-points, made by a small, square-edged drill, are necessary, which can be formed in approximal surface cavities of the incisors and cuspidati, in that portion of the dentine near the labial surface where it unites with the cementum, and in the same position in the palatine surface. These retaining-points can be made from the one-twentieth to the one-sixteenth of an inch in depth, and in addition a small undercutting on the wall next to the cutting-edge. In drilling the retaining-points in the cervical wall near the labial and palatine surfaces, the drill should be directed in a line with the long axis of the root, in order that the cavity made by it is sufficiently distant from the pulp of the tooth. The cavity being properly formed, dried, and protected from all moisture, the gold foil, prepared in the manner before described, is carried into the cavity with the introducing pliers or on the point of an instrument, and packed into the retaining-points until these are solidly filled.

The gold is then compactly built from one of these retaining-points to the other, and over the floor of the cavity, until a base is formed extending over the whole of the floor.

From this base the gold is then built to the orifice; and during the entire process it is packed a little higher about the walls than in the centre, in order to obtain a more thorough contact. When the gold has reached the orifice, the centre is then built up and the surface condensed and finished as before described.

Crystal gold is preferred by some for filling the retaining points and forming the base covering the floor of the cavity, on account of its retaining its position better than foil. This description of the method of introducing cohesive foil will apply to all cavities wherever situated, and need not be repeated hereafter. For crystal gold the cavity may be formed in the same manner as for cohesive gold foil, although many depend upon under-cuttings instead of retaining points for its retention.

The margin of the cavity to be filled should be uniformly shaped, to permit of the easy introduction of the gold over them when it is carried into the cavity, and the edges should be slightly countersunk, to protect them from fractures and to permit of a more perfect adaptation of the gold to the margins, and also to properly define the margins of the filling in the process of finishing the surface. Such directions will apply to all cavities in teeth during their preparation for filling.

FILLING THE SUPERIOR MOLARS AND BICUSPIDS.

I. *With Non-cohesive Gold Foil.*—In describing the manner of filling a cavity in each of the principal localities liable to be attacked by caries in the above-mentioned teeth, the writer will begin with the grinding surface of the first molar on the right side. The directions given for filling a cavity here will, with a few exceptions, be applicable to the introduction of a filling in the grinding surface of any of the upper molars or bicuspids.

When the cavity is very deep and its circumference not large, it is difficult, if not impossible, to make a filling sufficiently firm and solid in every part by the introduction of folds of gold long enough to extend from the bottom to the orifice. The operation, therefore, should be divided into two parts; two-thirds of the cavity should be first thoroughly filled with vertical folds, and afterward the remaining third in the same manner.

In filling a molar or bicuspid on any part of its surfaces the head of the patient should, for the most part, occupy very nearly the same position and have the same elevation as required for an operation on an incisor or cuspid. The cavity being prepared for the filling, and one end of the roll or ribbon of foil placed in it, the tooth may be grasped with the thumb and forefinger of the left hand of the operator—the former placed on the buccal surface in such a manner as to press back the commissure of the lips, and the latter on the palatine surface; then fold after fold may be introduced and forcibly pressed against the posterior wall until the cavity is filled. For this purpose an instrument may be used like the one represented in Figs. 466 or 469. If the former is used, it is to be held as shown in Fig. 463. The extruding portion should then be condensed with the same instrument as the one used for introducing, and still more condensed, if necessary, with pluggers similar to Figs. 470 and 471.

As a general rule, filling a cavity in the grinding surface of an upper molar or bicuspid is an exceedingly simple operation, requiring less skill than the introduction of a filling in any other locality in these teeth; but there are cases in which it is rendered very difficult, as, for example, when there are one or more fissures or carious depressions radiating from the main cavity. After the caries has been removed and the fissure enlarged, which was often a very tedious operation before the use of fissure burs with the dental engine, it requires considerable time and skill to fill these thoroughly. When it is not properly done, as is too often the case, a recurrence of the disease will soon take place, and thus defeat the object for which the operation was performed.

The introduction of a filling in the grinding surface of the second or third molar of a person having a very small mouth is sometimes attended with great difficulty; in some cases it can only be done with an instrument having a point bent nearly at right angles with the stem, like the one represented in Fig. 471; consequently, the power required for introducing and consolidating the gold is applied to great disadvantage. But the instrument represented in this cut is only intended for the first part of the operation of consolidating the metal; for its completion smaller points are required.

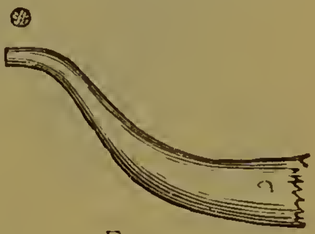


FIG. 471.

In filling a cavity in the grinding surface of a first upper molar on the left side of the mouth, the thumb of the left hand may be placed against the left cuspid or first or second bicuspid, as may be most convenient to the operator, while the forefinger is placed behind the point of the instrument and at the same time made to push back the commissure of the lips. To obtain a good view of the cavity in a second or third molar during the operation, the cheek should be pressed from the tooth with the forefinger of the left hand; but this finger can seldom be carried far enough back on this side of the mouth to be placed behind the point of the instrument. During the introduction of gold the instrument should be grasped as in Fig 463, or, better still, as in Fig. 467.

In filling a cavity in the anterior approximal surface of a right superior molar or bicuspid, the operation may be commenced by placing the gold against the palatine wall and ending at the buccal. But before the process of condensing is commenced every portion of the surface ought to be thoroughly tested with a wedge-pointed instrument, and wherever the point can be forced into the gold the cavity thus formed should be filled. The instrument employed for the introduction of the gold may be like the one represented in Fig. 466, but having a rather longer point and grasped as in Fig. 463. For condensing the extruding portions, either or both of the instruments represented in Figs. 460 and 464 may be used, as also the one employed for the introduction of the gold. During this part of the operation the instrument may be held as before, or as seen in Fig. 473, which permits a much greater amount of force to be applied than when held in any other manner.

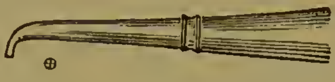


FIG. 472.

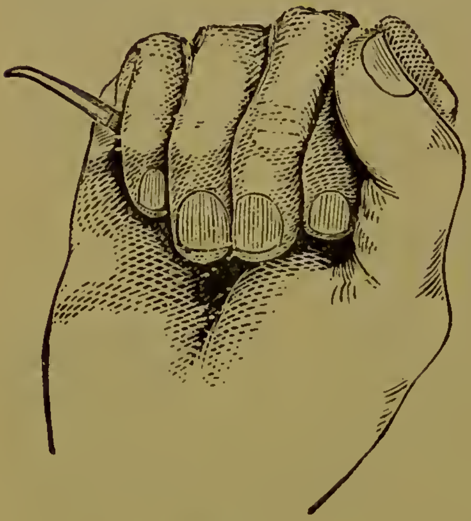


FIG. 473.

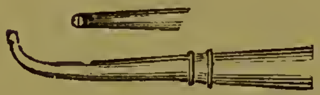


FIG. 474.

Nearly the same method and the same instruments are required for filling a corresponding cavity on the opposite side of the jaw. When practicable, the forefinger of the left hand should be placed on the palatine surface of the tooth, and the thumb against the buccal surface, and in addition to the instruments recommended for the right side of the mouth the one shown in Fig. 458 may be very conveniently employed to introduce the gold; also Fig. 460 or 474 in condensing the surface of the filling. The writer finds this last particularly valuable in very many cases.

A cavity in the posterior approximal surface of a superior bicuspid on either side of the mouth can, in the majority of cases, be as easily filled as one in the anterior approximal surface. The position of the left hand is very nearly the same, and in the introduction of the gold the first folds are placed against the palatine wall of the cavity. By commencing on this side the operator is enabled to lay the folds more compactly than he could were he to commence at any other point. He also has a more perfect control over the instrument in this part of the operation, and has a better view of the cavity during the introduction of the gold. For consolidating the filling, the instruments represented in Figs. 459, 460, and 465 are as well adapted to the purpose as any that can be employed.

When the mouth of a patient is large, a filling can often be introduced with nearly as much ease in the posterior approximal surface of a first or even a second upper molar as in that of a bicuspid; but when the mouth is small and the cheeks fleshy, it often becomes a difficult and perplexing operation, although the same method is used; yet, as it is absolutely necessary to the introduction of a good filling that the operator should see the cavity and witness every part of the operation, his ingenuity is often taxed to the utmost in contriving the most suitable means to enable him to do it. A number of instruments for drawing back the corner of the mouth have been invented, but the writer believes there are none so well suited to the purpose as the thumb or forefinger of the left hand of the operator. If the operator will accustom himself to the use of a small mouth-glass held in the left hand whilst operating, he will be spared many back-breaking efforts to keep in view fillings on posterior surfaces. It is necessary to become familiar with the apparently reverse motion of the instrument as seen in the glass; also to accustom the three fingers of the left hand to act independently of the thumb and forefinger. But one of the most careful and skillful operators of this or any other country, Dr. Maynard, assured us that he worked from a reflected view in the glass with the same ease as where he had a direct view of the cavity, and obtained, in very many cases where he used the glass, an accuracy of view which direct vision could not give him.

Before dismissing this part of the subject there is one point to which the attention of the young practitioner should be particularly directed. Many, in other respects tolerably good, operators are most likely to fail in not introducing a sufficient quantity of gold in the upper palatine portion of the cavity. The author frequently meets with cases in which the walls of the cavity are perfectly sound and every other part of the filling well consolidated; but here, upon the application of a wedge-pointed instrument, the gold is easily perforated. He would therefore advise the inexperienced operator to test this by severe pressure with a sharp, wedge-pointed instrument, as well, indeed, as every part of the filling, before leaving the operation. There is also one other precaution applicable to fillings in the approximal surfaces of the incisors and cuspids, as well as of the molars and bicuspids; it relates to overlapping portions of gold under the free edge of the gum, which must be carefully and completely removed before the operation can be regarded as complete.

In filling a cavity in the buccal surface of an upper bicuspid or molar, on either side of the mouth, the gold may be introduced with the instruments represented in Figs. 456 and 466. The latter is better adapted for the left side, but may also be used on the right. The straight, wedge-pointed instrument may also be advantageously employed on this side. The first folds of gold should be placed against the posterior wall, proceeding from behind forward, and pressing the folds against each other as compactly as possible. When the cavity has a large orifice and is rather shallow, or in other respects badly shaped for the retention of the gold, the operation is often tedious, difficult, and perplexing. But under favorable circumstances a filling may be almost as readily introduced here as in any other part.

The palatine surface of a bicuspid or of a molar is rarely attacked by caries; on the latter it is usually seated in a depression at the termination of a fissure leading from the posterior depression in the grinding surface. It is usually situated near the posterior palato-approximal angle of the crown, about half way between the gum and the coronal extremity of the tooth. It sometimes happens that the walls of these fissures are affected with caries throughout their whole extent, requiring to be filled from the depression in the grinding to its termination on the palatine surface. In this case the portion of the cavity on the grinding surface may be first filled; then the operator may proceed to fill the palatine portion in the same manner as if it were a simple cavity, placing the first folds of foil, in the case of a right molar, against the upper and posterior side of the opening with an instrument like the one represented in Fig. 466. Great care is necessary to prevent the instrument from slipping. It often happens, too, that the orifice becomes choked with foil before the cavity is half filled. This, indeed, is liable to occur in filling any cavity in any tooth; and when it does happen, unless a sufficient amount of pressure is applied to make a free opening into it, the filling will be imperfect and the object of the operation wholly defeated. When the cavity is situated in a left molar, the gold may be introduced with the instruments represented in Figs. 456 and 469, placing the first folds against the upper wall of the cavity and proceeding downward.

A tubercle of greater or less size is sometimes found on the anterior palatine surface of a molar, near the crown. Between this and the body of the crown a deep impression is often seen, which becomes the seat of caries; but the removal of the diseased part and the introduction of a filling is so simple that a special description of the operation is not deemed necessary.

II. *With Cohesive Gold Foil.*—In forming cavities in the approximal surfaces of the bicuspids and molars it is essential, in the majority of cases, to separate the teeth either by means of pressure or by cutting away a portion of the crown.

When they are very close together it is often impossible to gain sufficient space by pressure, and it then becomes necessary to resort to the enamel chisel, file, or disc, cutting away a portion from each tooth when both are decayed, and from one only if the other is in a sound condition. The former practice in separating these teeth was to cut away so much of the entire approximal surface as to form a V-shaped space of sufficient extent to enable the operator to reach the cavity easily. But by this method the crown of the tooth was disfigured and a space formed in which food readily collected and became a source of considerable annoyance. To avoid this, the practice now is to cut through the grinding surface to the approximal cavity, mortising this opening, and thus preserve the palato- and bucco-approximal angles, while at the same time the shape of the opening through the grinding surface materially assists in the retention of the filling. In preparing these cavities for cohesive gold foil, at least two good retaining points should be made at the cervical wall and two under-cuttings at the cusps, which have been preserved by the method of gaining space just described. But one of these retaining points, in connection with the two under-cuttings at the cusps, will often secure the filling when the nature of the case will not allow of more being made.

In preparing a cavity on the posterior approximal surface of a molar tooth, access is obtained by cutting through the grinding surface in the manner before referred to; then, by means of instruments more or less curved, the buccal and palatine walls are made parallel with each other, under-cuttings formed at the cusps, and retaining points drilled in the cervical wall at different angles. Advantage is also gained from having the cervical wall slightly undercut. In introducing the gold into a cavity of this nature many prefer placing a polished plate of metal or a matrix back of the cavity, in the space between the teeth, and condensing the gold firmly against it in building up this portion of the crown. By this method a good support is obtained, and after all the gold necessary is introduced and consolidated the metal plate is removed.

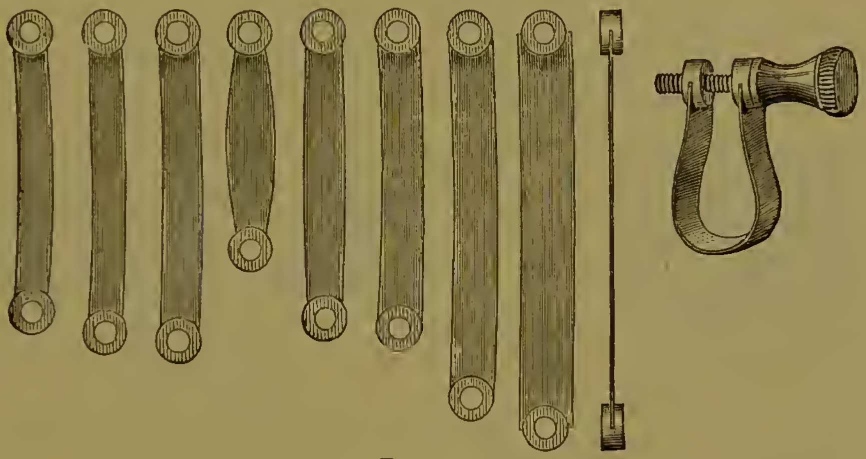


FIG. 475.

Fig. 475 represents a set of loop matrices, consisting of thin, flexible steel bars and a milled thumb-screw. To use them, one of the proper size is selected, the head with the smooth hole being passed over the thumb-screw; the screwed head is then bent around and the loop screwed to its place on the tooth.

Fig. 476 represents an ingenious matrix invented by Dr. Louis Jack. *a* shows the concave and wedging sides of the matrix, and *b* shows a matrix placed between two teeth ready to wedge and fill. *c* represents the form of pliers for placing a matrix in position.

The points especially notable in the use of a matrix are, to cut away the masticating surface of enamel to the depth of the cavity; to prepare the edges flat and smooth; to cut down to sound structure in the neck of the tooth, forming the base of the cavity, and shaping it so that the matrix will fit accurately on the cervical wall. Having excavated the cavity and cut a retaining groove along the buccal and palatal walls (terminating at the very surface of the masticating walls of the enamel), select a matrix the concaved surface of which matches the cavity. Then, after applying the rubber dam, finish and dry the cavity, place the matrix, and secure it with wedges of boxwood, which, being hard and dry, require very little forcing. The filling may be then done with the ease and certainty of a crown cavity with strong walls.

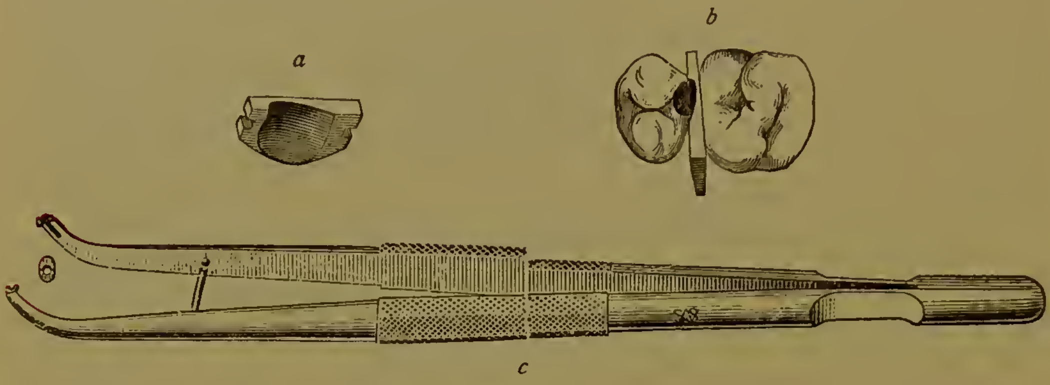


FIG. 476.

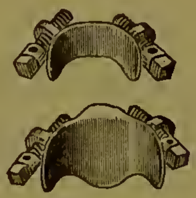


FIG. 477.

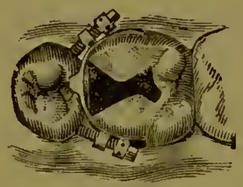


FIG. 478.

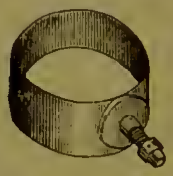


FIG. 479.

Figs. 477 and 478 represent the double screw matrices designed by Dr. W. A. Woodward, which, like those of Dr. Jack, occupy a single interdental space.

Figs. 479, 480, 481, 482, and 483 represent Dr. T. W. Brophy's matrices and their use in the forms of bands and screws.

Soft or non-cohesive foil should be used for the cervical margins and for the first half of the filling, because of the ease with which it may be adapted to the cavity walls and the rapidity with which it may be inserted; the masticating surface to be finished with cohesive gold. Wedge-shaped pluggers are the most desirable forms with which to condense the soft foil. If amalgam or cement be used the band should be oiled on the inner surface, to prevent the filling from adhering to it.

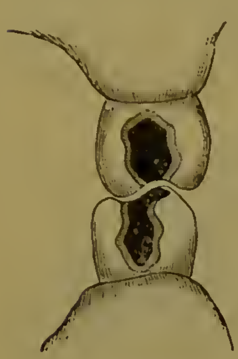


FIG. 480.

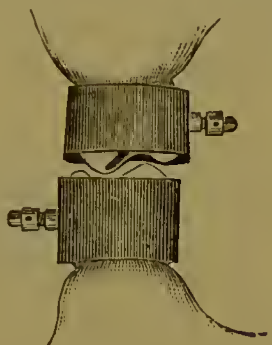


FIG. 481.

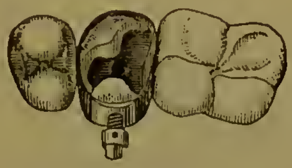


FIG. 482.

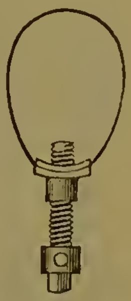


FIG. 483.

Figs. 484 and 485 represent Dr. W. B. Miller's matrices and their use. This matrix is commonly held firmly in place by reason of its duplex spring expansibility, but it may be additionally supported by a wedge of wood driven between the springs. Either the concave or convex edges go next to the gum, according as the cervical margin of the cavity is upon or beneath the gum, and a thick or thin matrix will be indicated by the width of the space between the teeth.

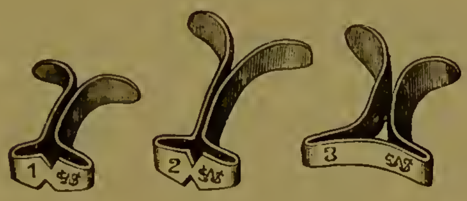


FIG. 484.

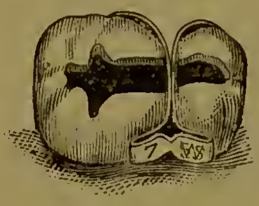


FIG. 485.

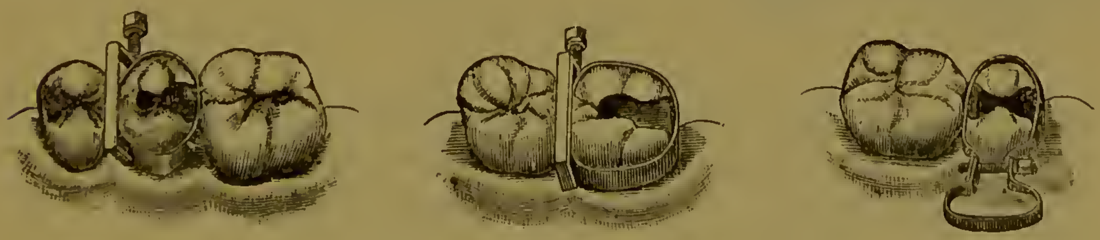


FIG. 486.

Dr. Guilford's band matrices and clamps are represented by Figs. 486, 487, and 488.

The Herbst matrix consists of a band of soft German silver, of the thickness 32 Am. gauge, about one inch and a half in length, and as wide as is necessary to cover the cavity in the proximate surface of the tooth. It is first fitted to the crown by bending it around, bringing both ends of the band to the buccal surface, and drawing them tightly together by the pliers. When the band is thus made to fit perfectly to the crown of the tooth to be filled, it is carefully removed and the joint soldered with soft solder, using muriate of zinc solution as a flux. This matrix is prepared before excavating the cavity.

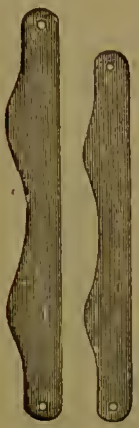


FIG. 487.

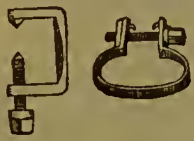


FIG. 488.

For the use of gold by the Herbst method, matrices are also employed made of gum shellac, which is molded to the tooth crown in a plastic condition, and then trimmed to the proper shape so as to form a supporting wall and not interfere with the introduction of the gold.

" Dr. Perry's matrix consists of a strip of metal to go about half way around the tooth and having a hole drilled through each end (Fig. 489). It is fastened around the tooth by means of a threading cord of floss silk, which is passed through the holes and tied fast with a double or treble knot (Fig. 490). The knot can be pushed out of the way upon one side of the tooth. The usual fault with matrices of this character is that they are made in different parts, one or more of which is liable to fall upon the floor, and they are in other respects difficult to manage. This one is very simple. You pass the threads through the holes in the ends, place the matrix where you wish to have it, wrap the thread around the tooth, and tie it (Fig. 491). If it stretches a trifle there is no harm done, because in packing gold there is a greater certainty of a close fit at the margins if the matrix yields a little. The matrix is made of very thin steel, and to prevent it from cutting the thread with which it is tied small pieces of metal are soldered to the ends, and the holes for the thread are drilled through those extra pieces of metal. This makes it so thick and firm that the thread can be drawn tight without danger of cutting it. The matrix is not universal in its application, and it is well to have others; but it is, in certain cases, a very good device. The holes are drilled in

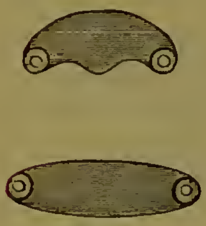


FIG. 489.

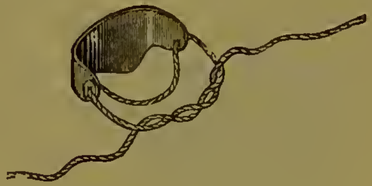


FIG. 490.

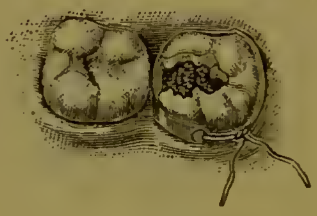


FIG. 491.

such a manner that the thread comes near the cervical wall, and the matrix is made to hug the tooth at that point. If it does not, a wedge of wood dipped in sandarac varnish and pushed between it and the adjoining tooth will cause it to fit well at the cervical border. This matrix is equally suited for gold or other plastics. It is particularly neat when amalgam is used, and it is often desirable to leave it on the tooth for a day or night. To avoid obstruction many narrow forms of this matrix may be kept on hand, some of which do not cover more than one-third or one-half the length of the tooth.

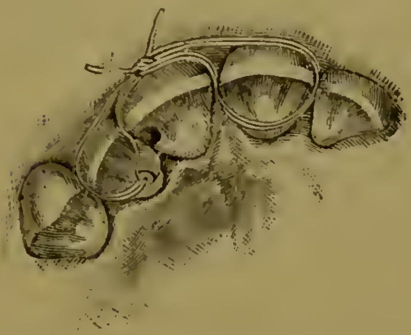


FIG. 492.

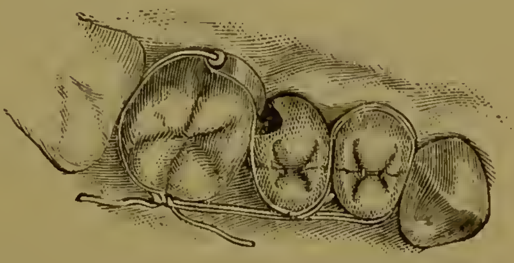


FIG. 493.

"There is another use to which the same matrix may be applied. It is that of adapting it by a simple method of binding and tying to any of the other teeth. Reference to the cuts will show how it can be easily applied to the incisors, which almost always should be filled from the lingual side (Fig. 492), and to the bicuspids and molars (Fig. 493), which can be sometimes filled from the buccal or lingual side without cutting down from the grinding surface. To one who reveres the shapes of the teeth this is an operation that is most satisfactory, and by the aid of this simple matrix it is more easily performed."

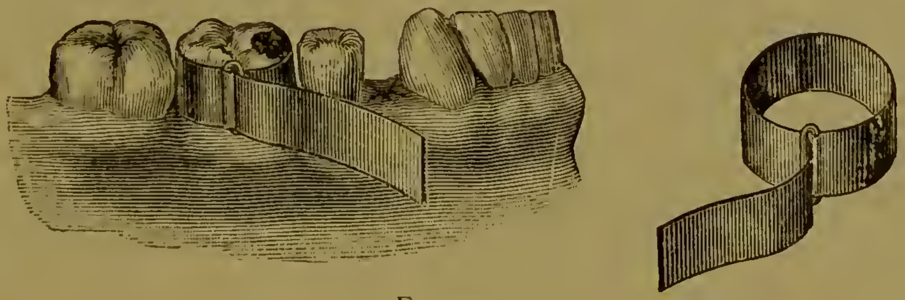


FIG. 494.

Fig. 494 represents the Weirich single band metal alloy matrix with a loop at the end.

To apply the matrix, place the band between the teeth, bringing the loop to the buccal side of the tooth to be operated upon ; pass the other end through the loop, drawing the band close around the tooth, then bend it sharply back on the loop and it will remain firmly in place.

To remove the matrix, merely reverse the movement, straighten the band, and slip it off.

Split teeth may be secured by gold bands or collars used in connection with oxychlorid or oxyphosphate of zinc between the fractured surfaces.

"Large contour restorations may be expeditiously made by means of the collars set tightly on the thoroughly prepared and dried tooth, which can then be filled with gold or gutta-percha or cement. For cutting the collars to conform to the cervical curves, an engine corundum point or Herbst rotary file will serve the purpose, and a collar so cut is shown by Fig. 495. To keep the gold as much as possible out of view, the collar should be cut as seen in Fig. 496. Platinum collars will be required when the filling is to be of amalgam, but a gold collar may be varnished with a mere film of collodion, copal, sandarac, or shellac varnish, at the part which is to come in contact with the amalgam, and then with proper care a dry amalgam will not combine with the gold of the collar. A thin collar, somewhat larger than the tooth, can be put in place, and a wedge of wood driven between the remaining portion of the tooth and the collar, to form a matrix, which, after the filling has been built in it, can be removed by first withdrawing the wedge. Such a matrix is illustrated in Fig. 497, and by this means many large and complex fillings may be rapidly and perfectly constructed."

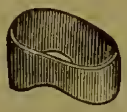


FIG. 495.

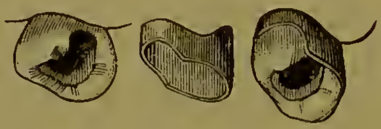


FIG. 496.

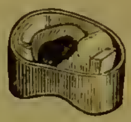


FIG. 497.

In filling grinding surface cavities in the molar teeth, where the decay has extended along one or more of the crown fissures, with cohesive gold foil or crystal gold, the gold is first introduced into the bottoms of the crown fissures and built up to their orifices, thus completing the filling of these fissures before the central cavity is filled. The fissures or sulci should be opened to their extreme limits and the ends be made round. Small curved chisels and fissure-drills are well adapted for preparing sulci, and the excavation should be commenced at the central part. In preparing cavities extending in the form of sulci or fissures over the buccal and palatine surfaces of the bicuspids and molars, all projecting portions of enamel should be cut away, so as to allow these cavities to be but little larger within than at their orifices; and the ends of the groove, which are usually shallow, should be made as deep as the center. One retaining-point may then be made in each of the two walls forming the ends of the groove-like cavity, or one retaining-point in the posterior wall, in connection with an under-cutting in the anterior one, will answer for the retention of the filling. In introducing the gold into a cavity of this form the retaining-points are first filled and the gold built across the floor of the cavity from one to the other, and from the base thus formed to the orifice. When a cavity upon the buccal or palatine surface extends under the free margin of the gum, it is necessary to either force the gum away by pressure with pledgets of cotton saturated with chlorid of zinc, when the cavity is not too near the pulp, or to remove the portion overlapping the cavity. The hemorrhage which follows this latter method may be checked by any of the hemostatic agents in use, such as tannin, phenol sodique, creasote, powdered subsulphate of iron, etc.

The application of chlorid of zinc will prove very effectual in such cases; also nitrate of silver, but the latter agent has a tendency to discolor the dentine.

FILLING THE INFERIOR INCISORS AND CUSPIDS.

The operation of filling a lower incisor or cuspid is far more difficult than filling an upper.

The constant tendency of the lower jaw to change its position is embarrassing to the dentist in operating on any of the teeth in it, and in case of the incisors and cuspids it is sometimes peculiarly perplexing. To prevent this all the effort the operator can make with his left hand is frequently required. From the backward inclination, too, of these teeth, it rarely happens that the gold can be introduced from the lingual side of the arch; consequently it is necessary to make the space as wide anteriorly as posteriorly. But as the teeth are comparatively small, the separation, when made with a file, chisel, disc, etc., should be no wider than absolutely necessary for the removal of the diseased part and the introduction of the gold. When, however, it can be done with safety, the separation should be made with a piece of rubber or other substance between the teeth, in the manner before described, or by rapid separation.

While operating on the lower teeth the head of the patient should occupy a more perpendicular position than while operating on the upper; this may be done either by lowering the seat or raising the head-piece of the chair. When by the latter it will be occasionally necessary for the operator to stand upon a stool five or six inches in height.

In filling a cavity in the right approximal surface of a lower incisor or cuspid with *non-adhesive gold foil* the following method is recommended. The cavity being prepared and a sufficient quantity of gold foil made into a small roll or folded lengthwise, as the operator may prefer, with the left arm over the patient's head, the chin is gently grasped with the left hand, while the thumb is placed against the lingual surface of the tooth, the forefinger serving to direct the gold and point of the instrument and also to depress the lower lip. The folds of gold, in their introduction, are pressed firmly against the lower wall of the cavity. The instrument employed for this purpose may be shaped like the one represented in Fig. 498, with a very small, wedge-shaped point, and held as in Fig. 467. The consolidation of the gold may be effected partly with the same instrument, partly with a round-pointed one shaped as shown in Fig. 499, and partly with an instrument shaped as in Fig. 465. The tooth should be firmly held between the thumb and forefinger of the left hand, to prevent it from being moved in its socket by the pressure of the instrument.

When the incisors are very small and the caries has spread over a large portion of the side of the tooth, it is often difficult to form a suitable cavity for the retention of the filling without penetrating to the pulp-cavity. In such cases the patience and skill of the operator are frequently taxed severely in obtaining a sufficiently secure support for the gold. But this he can usually do if he can make the bottom of the cavity as large as the orifice, even though it have but little depth.

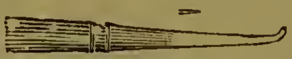


FIG. 498.

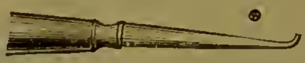


FIG. 499.

The manner of introducing a filling in the left approximal surface is very similar. The left arm and hand, as well as the thumb and forefinger, are all disposed of in the manner just described. The same instruments, too, may be employed for introducing and consolidating the gold, though in the first part of the operation the instrument, Fig. 461, may often be advantageously substituted for the one in Fig. 498. The instruments known as "rights and lefts," of different sizes, are very serviceable for filling all approximal cavities.

Nothing has been said with regard to fillings in the labial or lingual surfaces of lower incisors and cuspids. Although caries rarely attacks either of these surfaces of a lower incisor, it does sometimes develop itself in the labial surface of a cuspid; but the operation of introducing a filling here is so simple that a separate description of the manner of it is not deemed necessary.

The operation of forming cavities in the inferior teeth and introducing *cohesive gold foil* and *crystal gold* is the same as that described for the superior teeth, and a second description is therefore not considered necessary. As absolute dryness is essential in manipulating the cohesive forms of gold, the reader is referred to the various methods and appliances before described for drying cavities and protecting them from moisture. In filling the inferior teeth, the rubber coffer-dam will be found to be a valuable appliance for excluding all moisture from both the gold and cavity, and the saliva-pump an efficient adjunct to this dam for relieving the mouth of the saliva as it accumulates in prolonged operations. For controlling the movements of the tongue, a tongue and duct compressor has been used in connection with pads of bibulous paper placed upon the mouths of the ducts beneath the tongue. Prepared spunk has also been used successfully on the mouths of the sublingual and submaxillary ducts for controlling the flow of saliva. The rubber dam, however, will answer all requirements when used in connection with clamps.

FILLING THE INFERIOR MOLARS AND BICUSPIDS.

In filling a cavity in the grinding surface of a right lower molar or bicuspid, the operator may stand on the same side of his patient and a few inches higher than while operating on an incisor or cuspid. With his left arm placed over his patient's head, the tooth may be grasped with the thumb and forefinger of the left hand, while the middle finger is placed by the side of the chin; the other two should be placed beneath it. After preparing the cavity, *non-cohesive gold foil* may be introduced with an instrument like the one represented in Fig. 469, and held as shown in Fig. 463, pressing the folds against the posterior walls of the cavity.

In condensing the gold after the cavity is filled, use the instrument represented in Fig. 470. Sometimes, however, a greater amount of force can be exerted when this instrument is held in the manner shown in Fig. 473, previously wrapping it with the corner of a napkin to prevent the small part of the instrument from hurting the little finger. *The kind of instrument and the manner of holding it will, after all, have to be determined by the operator.* During the introduction and consolidation of the gold the lower jaw should be firmly held with the left hand, to prevent it from moving and from being too much depressed. This precaution is the more necessary, as the muscles of the lower jaw and the articular ligaments are seldom strong enough to resist the amount of force required in the operation.

In filling a cavity in the grinding surface of a tooth on the left side the dentist may sometimes operate to greater advantage by standing on the same side. In this case the commissure of the lips should be pressed back with the thumb of the left hand, placing it on or against the tooth to be filled, while the forefinger passes in front of the chin and the other three beneath it. As a general rule, however, he will be able to operate more conveniently by standing on the right side of his patient and holding the tooth and the chin in the manner before directed. In either case, the gold, in its introduction, should be pressed against the posterior wall of the cavity.

The foregoing general directions will be found, for the most part, applicable to the introduction of a filling in the approximal surfaces. When the crowns of the teeth are long and the cavity situated near the gum, the operation is sometimes very difficult and tedious, requiring all the patience and skill the dentist can exercise to accomplish it securely. This difficulty is increased when the shape of the cavity is unfavorable for the retention of the gold; or, in other words, when the cavity is shallow and has a large orifice. There is also another very serious difficulty which the operator encounters in the introduction of a filling in the approximal and also in the buccal surface of a lower molar or bicuspid. The flow of saliva is often so profuse that the whole of the lower part of the mouth is completely filled, and the tooth is inundated before it is possible to introduce a sufficient quantity of gold to fill the cavity. This not only retards the operation, but it also renders it more difficult and perplexing; for it is necessary to force out every particle of moisture from the cavity and from between the different layers of gold before the necessary cohesive attraction between them can be secured. If this is not done or, at any rate, if all the moisture is not forced from the cavity, and the gold sufficiently consolidated to render it impermeable to the fluids of the mouth, the operation will be unsuccessful to a great extent; hence the rubber dam is a valuable adjunct.

Ordinary foil (non-cohesive), when introduced in folds lying parallel with the sides of the cavity, keeps its place by the close lateral contact of the folds against each other and the walls of the cavity. Hence such fillings may prove successful, although done "under water," provided the lateral pressure is sufficient to force out the saliva from between the layers of foil. But if the folds are laid in parallel with the bottom of the cavity, the operation will fail, in consequence of the scaling off of the successive layers which have no cohesion. Crystal gold and cohesive foil fillings depend for their success upon the perfect cohesion of their component pieces; therefore the slightest moisture, or even dampness, while being introduced is fatal to their durability.

For the purpose of obviating this difficulty a variety of means have been proposed, the most important of which have already been described and need not be again referred to.

In the introduction of non-cohesive gold on the right side, it may be pressed against the buccal wall of the cavity on the left side, or against the lingual wall. Either of the instruments represented in Figs. 455 and 456 may be employed for the introduction of the gold, whether the cavity be situated in the anterior or posterior approximal surface of the tooth, and may be held in the hand in the manner shown in Figs. 463 and 467.

In filling a cavity in the lingual and posterior approximal angle of a first or second bicuspid, and especially from the loss of the tooth behind it, when there is a backward inclination of the organ, great care is necessary to prevent the instrument from slipping and wounding the lower lip. The most convenient position for the operator in this case is on the left side and partly in front of the patient. The tooth may then be firmly grasped between the thumb and forefinger of the left hand, or the thumb alone pressed against the outside of the tooth; in either case it is to be used as a rest for the ring finger of the right hand during the introduction and consolidation of the gold. But the locality of the cavity is such, especially when the mouth of the patient is small, that it can only be seen with great difficulty. Hence the operator is constantly liable to place the point of the instrument on one side of the orifice against an overlapping portion of gold, which, when pressure is applied, is cut through or detached. The instrument thus comes in contact with the hard, smooth enamel, and unless the hand is so guarded as to control its motions it is liable to slip and wound some part of the mouth, especially the lower lip, which accident, unless proper precaution is observed, may occur in filling any tooth.

Among the principal difficulties which the dentist encounters in filling a cavity in the buccal surface of a lower molar, apart from that of keeping the cavity dry until the gold is introduced, is the contact of the lower and inner part of the cheek with the tooth. This may, to a considerable extent, be prevented, and the commissure of the lips at the same time pushed back with the forefinger of the left hand of the operator, which also will serve, when the cavity is shallow and the orifice large, to hold the gold in place until a sufficient quantity is introduced to obtain support from the surrounding walls. In operating upon the bicuspids it is only necessary to depress the corner of the mouth to obtain free access to the cavity.

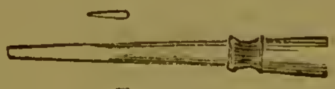


FIG. 500.

For the introduction of the gold on the right side, either of the instruments represented in Figs. 456 and 466 may be employed, but on the left side the latter will generally be found most convenient. A straight, wedge-pointed instrument (Fig. 500) can often be advantageously used in introducing the foil in either of the right bicuspids, and sometimes even in the first molar. This instrument can also often be used in filling a cavity in the grinding surface of a molar of either jaw, but oftener in the upper than the lower. It is scarcely necessary to say that the introduction of the gold should commence behind and proceed forward. The instruments represented in Figs. 459, 468, and 472 may be used in consolidating the foil.

It may be well to mention here that in filling a molar or bicuspid on the left side in the lower jaw, whether in the grinding, approximal, or buccal surface, the back of the chair, if so constructed as to admit of being moved, should be thrown five or six inches further back, to lower the head of the patient and give the face a more horizontal inclination. By this means the operator is enabled to approach the locality of his manipulations with greater ease, thus enabling him to exercise a more perfect control over his instrument, as well as over the mouth. But if the back of his operating-chair is stationary, he should stand upon a stool of five or six inches in height.

The precaution of removing all the overlapping portions of gold should never be omitted, and this sometimes constitutes a difficult part of the operation, especially when the cavity extends under the margin of the gum. For this purpose some of the files represented in Fig. 444 may be very advantageously used. Some are made straight at each end, others are curved. The cutting-burs operated by the dental engine, and also the corundum and sand-paper discs, are useful instruments for removing surplus gold.

The manner of building up the whole or a part of the crown of a tooth will now be described.

CONTOUR FILLINGS.

The term "contour" signifies "the line that bounds, defines, or terminates a figure; hence a "contour filling" is one that is made to conform to the line that defined the contour of the lost tooth tissue; in other words, the filling material is built up to such a degree as is necessary to restore the original form of the crown of the tooth.

It is scarcely to be expected that any one who has not had considerable experience in filling teeth, and acquired a high degree of dexterity in the use of instruments and the working of some one or more of the preparations of gold employed for the purpose, such as cohesive gold, will, simply from any directions that can be laid down upon the subject, be able at once to perform the operation of building on the whole or part of the crown of a tooth. But it is hoped that the following description may serve as a guide to those who have never attempted it, and may wish to exercise their mechanical and artistic abilities on this, the most difficult of all operations in dentistry.

Those only who are aiming at high excellence in this department of practice will be likely to undertake it; and should their first efforts prove unsuccessful, the increase of skill they will have thus acquired in the use of instruments will inspire new confidence, and ultimately, by perseverance, enable them to achieve the object of their wishes.

The operation, to be successful, must not only be performed in the most perfect manner, but the tooth itself must be situated in a healthy cavity and firmly articulated. Under other circumstances it would be useless to attempt the restoration of the organ. The general system, too, should be free from any preternatural susceptibility to morbid impressions.

A tooth on which this operation is called for has, in nearly every case, suffered so much loss of substance as to render it necessary, in cases where the pulp of the tooth is not exposed, that great care should be exercised in preparing the cavity for such a large mass of filling material, especially gold, and securely anchoring it. Where the exposure of the pulp of the tooth necessitates the destruction and removal of this organ the operation of "contouring" is much less difficult, as the pulp-chamber affords secure anchorage for the filling. Where the pulp has previously perished from inflammation and suppuration, the permanent preservation of the organ cannot be counted on with as much certainty as when it is destroyed by extirpation or by the application of an escharotic two or three days before the performance of the operation. Its destruction by the suppurative process is more apt to be followed by alveolar abscess; and this, having once established itself, must be completely cured, to prevent the liability to its recurrence. Hence, if the operation is determined on, the parts of the extremity of the root must first be restored to health; for without this it should never be attempted. The preparatory treatment in cases of this sort, as well as in cases of simple morbid secretion escaping from the root, is given in another chapter.

In describing the operation we will commence with the first molar of the left side of the superior maxilla. We will suppose that about three-fourths of the crown has been destroyed by caries and that the buccal wall is the only portion remaining, the pulp being more or less exposed. This is to be destroyed and extirpated to the extremity of each root; the decayed portions of the tooth are then to be removed, and the central chamber enlarged until the wall of dentine on the palatine, anterior, and posterior approximal sides are only about one line in thickness. On the inside of this wall a shallow groove or undercut is made and also retaining points, to give additional security to the gold.

The tooth as now prepared is represented in Fig. 501, and, after the application of the rubber dam, is ready for the introduction and building on of the gold. But before describing the manner of doing this it may be well to say a few words with regard to the preparation of gold most proper to be employed. For filling the roots, non-cohesive gold foil is the best. If the leaves are thick, weighing from fifteen to twenty grains, it should be introduced in very narrow strips, without folding, in the manner described in another chapter; if leaves of four or six grains are preferred, it may be cut in strips varying from an eighth to a quarter of an inch in width, according to the size of the canal in the root, and then rolled or made into very narrow folds. For the central chamber and crown, gold possessing cohesive properties should be employed; although this property may, to a degree, be imparted to common gold foil by slightly annealing immediately before using, cohesive gold foil possesses it in a higher degree, and this also requires to be annealed. Either kind of foil, therefore, or crystal gold may be employed. The operation, however, can be better performed with the cohesive foil or crystal gold than with the non-cohesive foil. Crystal gold is often used to fill the central chamber and act as a base upon which to build the cohesive gold foil.

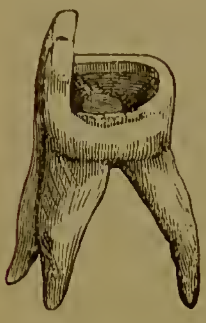


FIG. 501.

As the manner of filling roots is described in another place, we shall commence with the pulp cavity. The gold, supposing it to be cohesive foil, is loosely rolled into a fold or rope, from which pellets are cut. A sufficient number of these having been prepared, the surfaces against which the gold is to be placed are made perfectly dry by wiping with Japanese bibulous paper or absorbent cotton. This done, one of the pellets is placed in the central chamber with pliers, pressed into a retaining point, where the formation of such points is necessary, and consolidated with a small-pointed condensing instrument; another and another is added, each being consolidated as the first, until a sufficient number have been introduced to fill this chamber. The process of consolidation is now to be repeated and continued until no part of the gold can be made to yield to the pressure of the instrument; then additional pellets are applied and condensed as in the first instance, forcing those placed against the surrounding wall firmly and compactly into the groove or undercut made in it, thus securing for the entire mass the greatest possible stability. Again, pellet after pellet is applied, pressing those placed along the outer edge firmly against the enclosed margin of dentine and against the buccal wall of the tooth, until a solid mass considerably larger than the portion of the crown to be supplied shall have been thus formed. The same result may be obtained much more rapidly by using the gold in the form of a ribbon. In this case fold after fold of the gold is introduced, each fold being thoroughly welded and consolidated as introduced.

For the complete solidification of every part of the gold and the welding of every piece to the adjoining ones, a number of instruments are required, with serrated points, which are represented in the figures illustrating the instruments employed in the use of the cohesive forms of gold. For some parts of the operation a straight instrument can be employed most advantageously; for other parts, one slightly bent near the point; and for others, one bent at right angles with the stem. The kind most suitable for each case must be determined by the judgment of the operator. One, perhaps, may use very efficiently an instrument in a particular locality and for a certain purpose, that another, for the same purpose, would handle very awkwardly. But for completing the work of consolidation, all agree that very small-pointed instruments are indispensable. The consolidating or building instruments may consist of Varney's hand-mallet pluggers, or the points of the automatic or engine mallets.

As the cohesiveness of the gold is destroyed by the contact of liquids, it must be kept absolutely free from moisture during the entire process of introducing and consolidating the metal. But if, notwithstanding every precaution, the saliva should come in contact with the gold before its complete introduction, the unfinished surface must be thoroughly consolidated, then dried with some good absorbing substance, scraped, burnished, dried again, and made rough with a sharp-pointed instrument. To this surface fresh portions of gold can now be united, and sometimes made to adhere quite firmly, but often it is necessary to drill retaining points into the gold and continue the operation from these points. The use of the rubber dam and other appliances now enables the operator to perform prolonged operations without the danger from moisture which formerly existed.

The next step is to consolidate thoroughly every part of the surface. This may be commenced with the larger-pointed instruments. After going over it ten or a dozen times with these, smaller points may be used, and these again changed for still smaller, until no more impression can be made upon it than upon a solid ingot of pure gold.

It now remains to cut the surface until the gold is made to assume very nearly the shape of that portion of the original tooth the loss of which it supplies. The plug-finishing burs operated by the dental engine, the files for finishing the surface of fillings, and the corundum and sand-paper and stone discs and points, will be found serviceable for such operations. In doing this an opportunity is afforded to the operator for the display of much artistic skill and ingenuity. While shaping the grinding surface the patient should be requested, from time to time, to close the mouth, that the depression in it may be made to correspond to the cusps of the tooth with which it antagonizes, so that these two may touch simultaneously with the other teeth of the upper and lower jaws. This part of the operation is always tedious, usually requiring more time than for the consolidation of the gold. The use of articulation paper may facilitate this part of the operation.

The surface of the gold may now be rubbed with properly shaped pieces of Arkansas or Hindostan stone or with pulverized pumice until all the scratches left by the files are removed; then polish with crocus and a burnisher. The appearance of the tooth as thus restored is shown in Fig. 502.

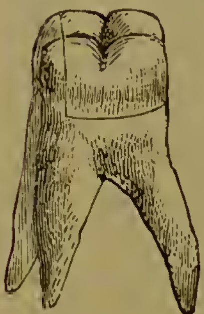


FIG. 502.

As it is impossible to perform the entire operation at one time, it may readily be divided into three parts, the *first* consisting in the extirpation of the pulp (when necessary) and the preparation of the tooth, the *second* in the introduction and solidification of the gold, the *third* in giving to the metal the proper conformation and in finishing the surface. The time required for the first, supposing the operation to be like the one just described, may vary from one and a half to two and a half hours; for the second, from two to three and a half hours; and for the third, from two to six hours, according to the difficulties to be encountered, the ability of the dentist, and the completeness of his preparation for the operation. Some, perhaps, may prefer crystalline or sponge gold, supposing it to be more easily welded than cohesive foil; but as the manner of working this variety of gold has already been described, it will not be necessary to give additional directions for its use.

The late Dr. M. H. Webb, an expert operator in contour work, gave the following directions for completing such an operation:—

"When the foil has been prepared and impacted as described, and so that the substitution for the lost tissue is complete, a fine saw or suitable file should be used to cut away the surplus material and to aid in making the filling conform to the original contour of the part, after which narrow strips (a line or ⅛-inch wide) cut from fine emery cloth should be so manipulated as to properly form and finish the surface of the gold. When this has been done and the rubber dam removed, the finishing should be completed by the use of fine pumice and silex upon linen tape, as before suggested. The gold at the masticating surface should be finished with fine burs, and by their use made concave or to conform to the original type of the part operated upon. The gold should be so impacted as to be flush with the prepared margin of enamel, yet even then made concave when such concavity is indicated. Fine burs should be used for the purpose of trimming and shaping such fillings, because the form of the remaining part or parts of the cusps and prepared edges of enamel against which the gold is placed may be changed and the teeth made less useful when corundum cones are used. The polishing of the gold upon the surface referred to may be done with pumice and silex, mounted upon suitably shaped points of wood, leather, or rubber.

"Whether the cavity is large or small, the gold ought to be built out to the original contour of the part and at its periphery, a little beyond the margin, then finished down to the surface of the enamel, and the whole filling made to conform to the line that defined the contour of the lost tissue. If the gold be not impacted against, and be not flush with, the edges of the enamel, the operation is not such as is demanded for the preservation of remaining tissues. A plain surface of gold should not be made, because the tooth thus operated upon and the one adjoining may approximate closely and disintegration of enamel take place near or at the part in contact. Restoration of contour prevents such contact, and this prevention is necessary, especially when the tissues of the organ operated upon are not fully calcified. When operations have been so performed as to entirely prevent fluids or semi-solids from entering between gold and the tissue against which it has been placed, the gold tint may be seen through the light walls or edges of translucent enamel soon after the removal of the rubber dam and completion of the operation. If an opaque or dark line or spot be visible at or near the parts where gold ought to be in contact with dentine and enamel, the operation has been imperfectly performed, and chemical action may soon follow and the entire filling prove a failure."

The operation of building on the entire crown of a tooth should be proceeded with much in the same way as just described for part of the crown. If too large pieces of either crystal gold or foil are used at one time, the surface will become crusted over by the pressure of the point of the instrument, and this will prevent, by any subsequent force that can be safely applied, its thorough consolidation. In this case the general mass will be more or less spongy and the operation imperfect. The dentist should be well assured, therefore, as he progresses with his work, that every successive layer is firmly adherent to the preceding one. To build up an entire crown requires more time; perhaps, also, more skill, as there is no wall of tooth substance to give partial support. In other repects it resembles the previous operation.

It was suggested by the late Prof. Austen, as a plan to avoid much of the tediousness of the second stage of this operation, to fill the pulp cavity, inclosing in the center a screw-cut, notched, or double-headed pin, and carrying the gold over the edges of the cavity; make this surface somewhat irregular in shape, but finish it smoothly, and trim the circumference to the exact size of the tooth; take a wax or plaster impression of the surface, and fit to the plaster model a lump of gold, having in the center a hole larger than the pin projecting from the root; shape and polish it *out* of the mouth, then set it in place and secure it by filling with gold around the pin. If the color is not objected to a vulcanite crown could be very perfectly adapted in this manner; or a porcelain tooth could be made, hollow in the center, with pins or a dovetail to hold a thin layer of vulcanite, by means of which it could be fitted with perfect accuracy to the prepared root. Prof. Austen thought that in this way the root will be less injured, and the union between the gold and the root less disturbed than by the long-continued and severe pressure of the ordinary operation. While the artificial crown is being made he suggests a temporary gutta-percha crown to prevent any irritation from the projecting pin.

A large portion of the crown of a tooth may be built up with ordinary gold foil if it be of the best quality, but the cohesive preparations, either foil or crystal gold, are preferable. The manufacture, however, of porcelain crowns well adapted to all forms of teeth, as well as the introduction of porcelain facings, or sections of crowns, for attachment to remaining natural portions, afford many advantages in restoring the lost portions of the teeth over that of building up with solid gold. See Fig. 506.

We have endeavored in the foregoing description to point out the general method of procedure in the operation of which we have been treating. We have also noticed some of the precautions necessary to be observed; but unexpected difficulties are sometimes encountered, the peculiar nature of which it is impossible to anticipate. Few, however, are of so formidable a character that they cannot be overcome.

During the operation of building up a portion or the whole of a crown with cohesive gold, if, in condensing it, any part becomes displaced or fails to unite with that already introduced, it should be removed, otherwise the filling will prove defective; and this rule will apply to all fillings of this form of gold. Each piece, as it is introduced, must be firmly attached to that already in position, and no doubt should exist concerning secure anchorage. When a contour filling, which includes a portion or the whole of the masticating surface of a bicuspid or molar, has been properly inserted, and the gold built up flush with the margins of enamel, such a surface should be made to correspond to the original surface in form, by making it concave by means of the fine finishing burs or corundum points used with the dental engine, when it may be polished with pumice and silex, applied by properly-shaped points of wood, rubber, or leather. In all such building up the gold should be carried beyond the margin and then cut down to the surface of the enamel, preserving the original contour of the part as much as is possible. By the aid of matrices the contouring of approximal surface cavities, especially posterior ones, is greatly facilitated, as they enable the operator to adapt and impact the gold in a perfect manner.

To retain the gold of contour fillings in large, saucer-shaped, and other forms of cavities, screws made of fine gold, securely anchored in the dentine, with free ends projecting above the surface around which the gold is built, are available.

Fig. 503 represents Dr. How's retaining screws and instruments for their introduction. A shows a cone-socket screw-driver with a sliding split tube which serves as an adjustable holder for the screw, in the end of which is a slot, such as the operator may readily cut with a No. 5 separating file. On placing the screw in the holder, the driver blade will enter the slot, as shown in partial section by B. C shows in its palatal aspect an incisor wherein the apical portion of the pulp chamber has been properly filled and the main portion drilled and tapped with an A tap and drill. The tap is so set in the tap-chuck as to be a gauge by which the screw-post may be cut as much shorter than the gauge as will let the screw, after it has been placed in the holder (see B) and carried to its place in the root, project as shown in C. D shows a molar in the palatal root of which a B screw has been likewise inserted. It is obvious that large contour fillings may be securely built around screw-posts thus firmly fixed in the roots of such teeth.

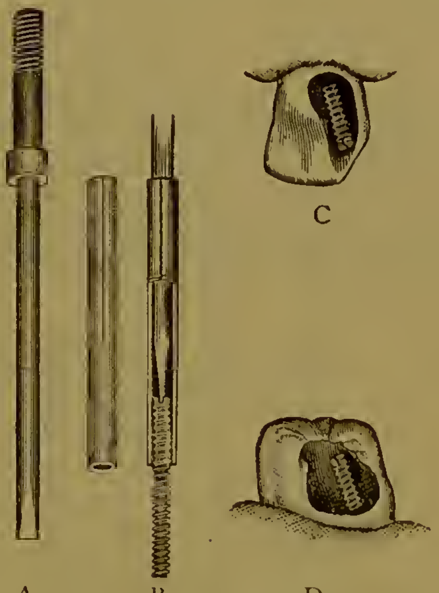


Fig. 503.

Fig. 504 represents Dr. E. Osmond's screws for securing gold fillings, with the instruments necessary for their introduction.

A A are screws made of 20-carat gold wire, annealed, split about half-way, once or twice, so as to form two or four arms when opened. B is a screw-driver, surrounded by a tube for the purpose of holding the screw and carrying it to its place in the tooth. C is a drill, for the purpose of drilling a hole, which is afterward tapped by the tap-screw D.

Figs. 1 and 2 are teeth with large saucer-shaped cavities, such as we very frequently find; but other cases in which these screws are available will readily suggest themselves to the mind of the experienced operator.

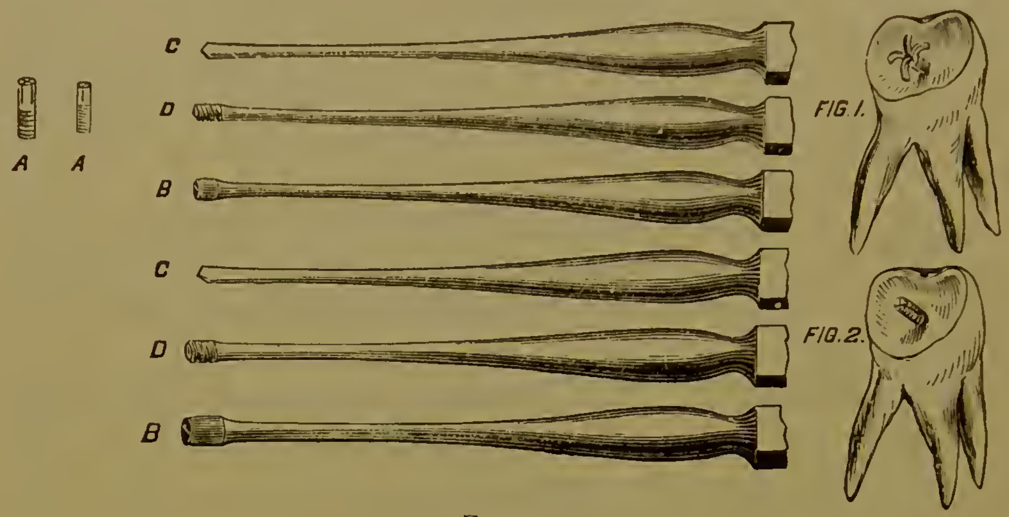


FIG. 504.

Fig. 505 represents the instruments for manipulating what is known as the St. Louis system of retaining screws.

In this set of instruments the drills, taps, and wire fitted for each other bear corresponding numbers, as 1, 2, 3.

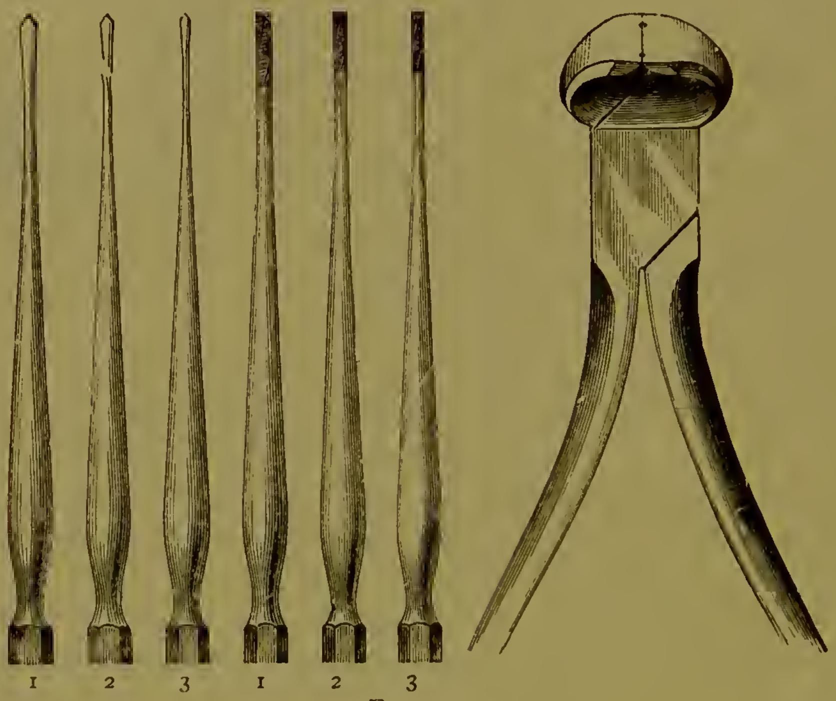
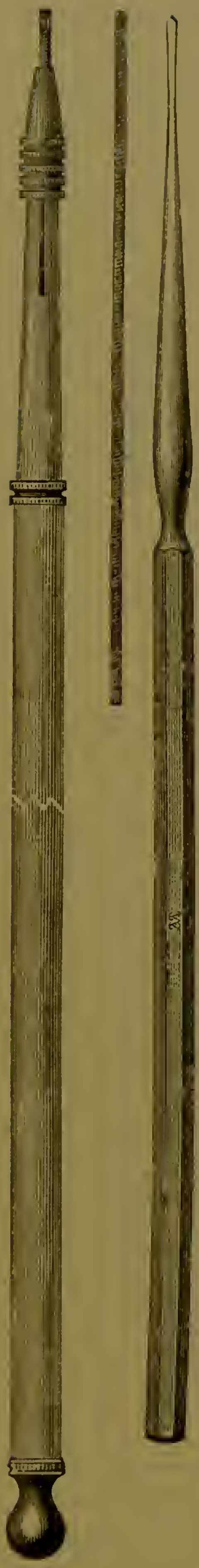


FIG. 505.

The wire-holder is made adjustable to take either size of wire.

The cutting edges of the cutting pliers are formed with two round openings, as shown in the cut. The long wire to be used, if put in



one of the openings, can be "nicked" at the proper distance to form the screw while in the wire-holder, so that after having been screwed into place it may readily be broken off without the use of file or pliers in the mouth.

Fig. 507 represents anchor screws, drills, and taps.

Cut No. 1 shows the size of the 18-carat gold anchor screw.

No. 2. Iridio-platinum anchor screw, same diameter, but longer than No. 1.

A. Anchor screw magnified to show thread and slot.

No. 3. The starting or center drill will form a pit at the exact point desired; but if this point be not at first obtained, the pit center may be moved laterally while the drill is revolving.

B. Point of center drill magnified.

No. 4. Limit or anchor drill; will bore only to the depth determined by the limit shoulder,—half the length of screw No. 1.

C. Point of limit or anchor drill magnified.

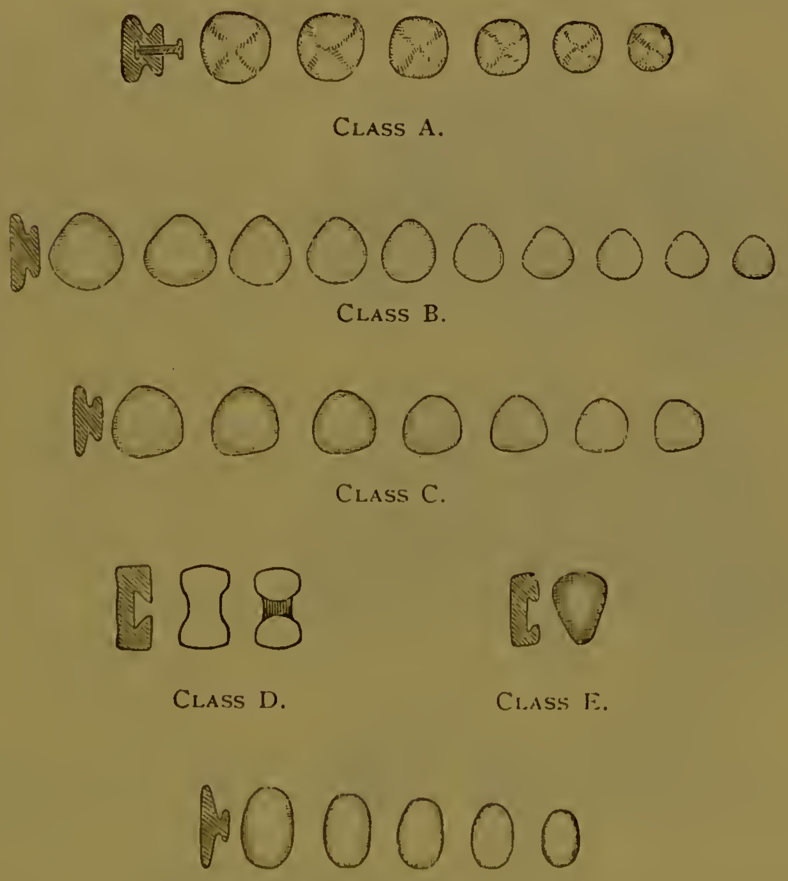


Fig. 506.

No. 5. Screw-tap, its diameter being only thirty one-thousandths (.030) of an inch.

No. 6. Screw-driver and sleeve which holds the screw for insertion or removal, as shown magnified at D.

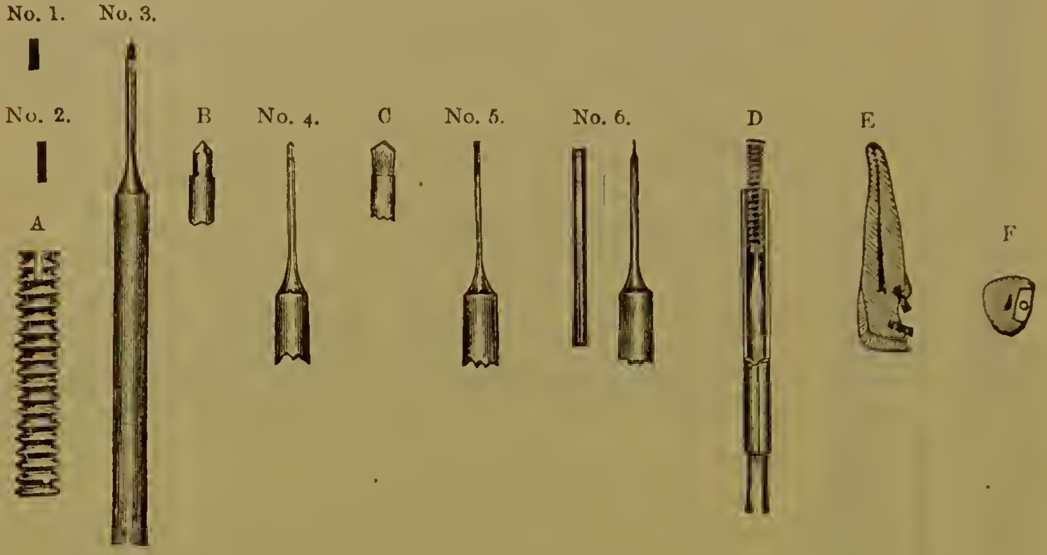


FIG. 507.

E and F exemplify the anchor screw in gold contouring operations. A drilled and tapped hole to be filled with gold foil serves as a superior retaining point.

Under the head of "Contour Work" reference may be made to the use of forms or facings of porcelain, as shown in Fig. 506, for filling cavities of decay.

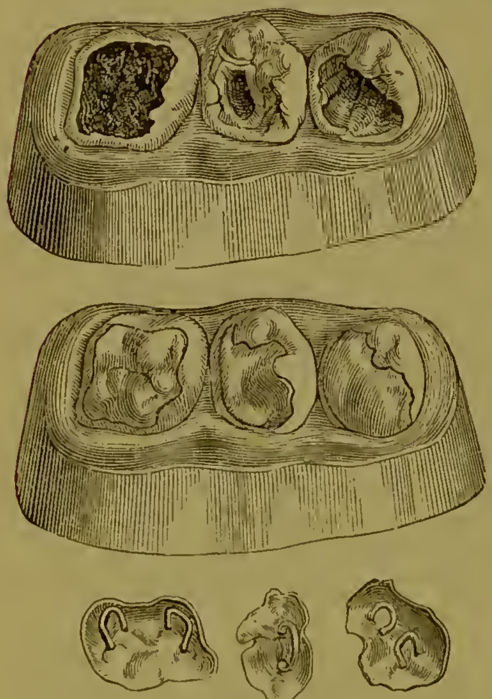


FIG. 508.

These are to be used in conjunction with oxychlorid or oxyphosphate of zinc, gutta-percha, or they may be set in amalgam. Used on an articulating surface, they have the advantage of a hardness at least equal to the most solid metal filling. They may also be used to avoid the display of more noticeable filling material.

For what is commonly called "bridge-work" the reader is referred to the article on "Preparation of a Natural Root and Attachment of an Artificial Crown."

Fig. 508 represents Dr. B. J. Bing's method of capping a carious or broken tooth. It consists in properly preparing the walls of the cavity, and taking an impression of it with wax or modeling composition. Dies are thus obtained, upon which gold caps are struck. Small loops or rings are soldered to the bottom of the caps, which are secured in the cavities by gutta-percha or oxyphosphate of zinc.

Outfit of Operative Instruments.—A student's set of operative instruments may consist of a limited number of instruments, such as pluggers, chisels, scalers, foil carrier and plugger combined, excavators, dental engine instruments, pulp cavity pluggers, drills and extractors, files, syringe, Arkansas stone, foil shears, foil folder, mouth mirror, rubber dam, rubber-dam holder, rubber-dam clamps, rubber-dam clamp forceps, the hand or automatic mallet, chamois skin, orange wood, linen tape, burnisher. The heavy and expensive instruments, such as the dental engine, extracting forceps, and dental chair, are usually furnished by the dental schools. A number of dental chairs are in use at the present time, which combine all of the different movements required by the dental practitioner.

CHAPTER III.

FILLING TEETH OVER EXPOSED PULPS.

THE pulps of the teeth may be exposed by mechanical injuries and by caries; the first may occur from falls, blows, the careless excavation of carious cavities by means of the engine-bur or the excavator, while the latter is the result of the destruction and disintegration of the tooth-structure to such a degree as to expose the organ, which becomes irritated as a consequence, and, if the irritation is continued, leads to its suppuration, ulceration, and death. The propriety of filling a tooth after the invasion of the pulp-cavity by caries without first destroying the pulp was for a long time doubted by many practitioners. It was thought that inflammation and suppuration of the pulp must necessarily result from the operation. But Dr. Koecker, who was the first to recommend filling a tooth under such circumstances, cited a number of cases in which he performed the operation successfully.

The earlier attempts at capping exposed pulps were for the purpose of preserving the organ from the contact of air and from pressure during the introduction of the crown-cavity filling, and consisted in the medication of the pulp with creasote or a combination of creasote and tannic acid, and later with carbolic acid, and its further protection by means of some form of cap.

The results, however, were unsatisfactory, and a correct method of treatment was first suggested by Dr. Keep, who employed a paste of chlorid of zinc, which was applied to the exposed pulp, which completely filled the space around the point of exposure, and thus prevented any receptacle in which effused serum or lymph could accumulate. The irritating effects of the chlorid of zinc, however, were such that this method was modified by substituting for the stronger zinc chlorid a weaker solution, which permitted its neutralization and thus diminished its power to irritate the pulp. Later, the oxyphosphate of zinc was substituted for the oxychlorid, the surface of the pulp being dressed with either pure or diluted carbolic acid.

The method of Dr. King, that of combining pure oxid of zinc with pure wood creasote, or carbolic acid, as a pulp-capping paste, which is flowed over or carefully applied to the pulp, has received a wide acceptance and given satisfactory results. This paste is covered with a layer of either the oxychlorid or the oxyphosphate of zinc, and the crown cavity filled temporarily with either of the zinc preparations, or gutta-percha, or Hill's stopping. A modification of Dr. King's method consists in first applying pure carbolic acid to the exposed surface of the pulp to produce a superficial coagulation, and then to cover it with a concave cap of platinum filled with the paste composed of oxid of zinc and equal parts of carbolic acid and oil of cloves, and then filling the remaining portion of the cavity with any of the plastic materials.

It is the practice of some to coat the surface of such concave caps in contact with the pulp with a solution of gutta-percha and chloroform, which acts as a non-conducting substance and is tolerated by the sensitive organ, owing to its anodyne and protective properties. The interposing substance may be held in place within the cavity by a delicate excavator or nerve instrument, and the oxychlorid, of thin consistency, flowed over it, when the remaining portion of the cavity can be filled with the same material in the form of a thicker paste. A portion of this material is afterward removed for the accommodation of a more permanent filling. Caps of tin of a thickness of No. 28, and of platinum No. 30, the concave surfaces filled with the paste of oxid of zinc, carbolic acid, and oil of cloves, or with a solution of gutta-percha and chloroform, and carefully applied over the point of exposure, will often prove serviceable in restoring the pulp to a normal condition. It is suggested that such caps be inserted edgewise, in order to prevent the direct pressure of the air or the paste on the sensitive organ. Over the metal cap a temporary filling is introduced

—one which requires little force for its introduction and of low conductivity. For such purposes the zinc preparations are commonly employed, although some prefer gutta-percha, tin, or amalgam. The zinc preparations when employed for such temporary fillings should not be neglected, owing to their liability to disintegrate near the margin of the gum. Asbestos, either alone or enclosed between layers of gold or tin foil, has also been employed as a capping, concave discs being formed when metal is used in combination with the asbestos, the inner surfaces of which are coated with the solution of gutta-percha and chloroform. Thin card-board paper, in the form of caps saturated with carbolic acid, has also been employed as an interposing substance between the point of exposure and a filling of the zinc preparation. Dr. W. C. Barrett has been successful in capping exposed pulps with the lactophosphate of lime, which is applied as an immediate cover to the exposed tissue, and which is prepared as follows: on a piece of glass or porcelain is placed a drop of Merck's lactic acid, to which as much magma phosphate is added as it will digest; it is then reduced to the proper consistency by adding the dry precipitated phosphate. The magma phosphate must be kept under water. It has been found that the lactophosphate of lime, prepared as above, is very congenial to the pulp.

Although bathing the exposed surface of the pulp with pure carbolic acid is practiced by many prominent dental practitioners, some contend that the escharotic action of the agent may prove injurious, and hence use either a diluted form, or the pure crystallized carbolic acid rendered fluid by a small quantity of chloroform; others assert that the results desired cannot be effected by a dilute solution of carbolic acid, owing to its greater affinity for water allowing it to be absorbed to a much greater degree, and causing more irritation and less coagulation than the pure form. It is very essential, in the treatment of cases of exposure of the pulp, that a due regard be paid to the condition of the organ, and the difference between normal and abnormal sensitiveness determined. If it is a case of simple exposure, after carefully preparing the crown cavity and the margin of the opening leading to the pulp, after syringing with tepid water, all moisture should be carefully removed, and a drop of the solution of gutta-percha dissolved in chloroform applied on the point of a delicate instrument (some prefer dilute tincture of aconite or a thin coating of glycerin or collodion), and the cavity filled temporarily with wax or cotton, the tooth remaining at rest for a few days and protected from irritation.

When everything has progressed favorably for such a period the operation of capping may be performed. Should the pulp be irritable or the seat of acute pain when first examined, the cavity should be syringed out with tepid water containing a sufficient quantity of carbonate of soda to render the solution slightly alkaline. Such an application will relieve the pain, even if it is acute. The application of lead water is often useful for the same purpose, or the dilute tincture of aconite, or a solution of the sulphate of atropin.

Professor James H. Harris recommends the following method of treating teeth with exposed pulps: "First remove all decomposed dentine, for if any dentine in such a condition is allowed to remain, the progress of decay will continue and cause inflammation of the pulp, finally resulting in its destruction. Even if the carious portion *is* entirely removed and the pulp *not directly exposed*, we still need not be too confident of the ultimate preservation of the vitality of the tooth, for the *probability* is that the dentinal fibrillæ die in advance of the actual *decomposition* of the tooth substance, and hence, before the decay has actually reached the pulp, this organ may have assumed a condition from which recovery is impossible. Still, however, every attempt should be made to preserve the vitality of the pulps of the teeth, and with this object in view, having removed all of the decay, should any hemorrhage occur it may be arrested with spirits of camphor or with camphor and tincture of opium. The entire crown cavity should now be carefully filled with a *temporary filling* of Hill's stopping, avoiding undue pressure upon the pulp. The first piece of the Hill's stopping may be more safely adapted by first moistening it with chloroform.

"This temporary filling should be removed from time to time, as may be necessary, during a period of from one to five years, according to the health of the patient, extent of exposure, etc. With this treatment the reparative process will more readily go on, and when the pulp is found to have become protected by a layer of osteo-dentine a permanent metallic filling may be inserted.

"As a further precaution against danger to the pulp, a layer of Hill's stopping or of oxyphosphate of zinc may be placed in the bottom of the cavity and the permanent filling inserted over this. Sometimes, when the exposure is quite large, it will be found well to cap the pulp with a *thin mixture* of oxyphosphate of zinc, as this material can be more readily adapted to the exposed pulp without danger of producing undue pressure. But even when this method is pursued it is best to first coat the exposed surface of the pulp with a solution of gutta-percha and chloroform, in order to protect it from the slightly irritant effect of the oxyphosphate. The oxyphosphate first introduced should be mixed thin and allowed to harden, when the remainder of the cavity should be filled with the same material mixed stiffer, especially when the cavity involves the grinding surface, where a portion of the filling is subjected to the friction of mastication. Sometimes, in large grinding surface cavities, after capping and filling the cavity two-thirds full of Hill's stopping or oxyphosphate, the filling may be finished with amalgam, which is permitted to remain as a test-filling for from three to six months, when, if no symptoms of pulpitis manifest themselves, such as paroxysms of pain caused by heat and cold, and gradually becoming constant, a portion of the temporary filling (about one-third) may be removed and the cavity filled with amalgam, which is allowed to remain, as before stated, from one to five years. Then the amalgam may be removed, and, if necessary for the support of the gold to be substituted, a small portion of the Hill's stopping or the oxyphosphate, and a gold filling inserted. In removing the temporary filling, preparatory to inserting a gold filling, the condition of the dentine should be carefully noted—whether it is normally sensitive or not, as the pulps of teeth often die from chronic inflammation without pain to the patient, in which case the dentine would be devoid of sensitiveness. Ossification of a pulp renders the dentine painless. During the removal of a portion of the temporary filling, should the dentine be found not sensitive, the operation of removing the temporary filling should be continued until the cause of such want of sensation be ascertained, whether due to the death of the pulp or its ossification.

"In performing the operation of 'capping' the rubber dam should be applied if possible.

"In the treatment of cases of exposure of the pulp a careful record should always be kept, as it is impossible to remember the peculiarities of each case extending through a long period of treatment."

Traumatic exposures of the pulp, or those which occur from accidents, such as fracture of the teeth or careless use of dental instruments, should be treated by the application of diluted tincture of calendula to the exposed surface, and the pulp then capped by a gold or platinum concave cap filled with the oxid of zinc, carbolic acid, and oil of cloves paste, and a permanent filling in the cavity. Cases of accidental exposure of healthy pulps admit of immediate treatment, as a general rule, without unfavorable results.

In cases of long exposure it has been recommended to wash out the cavity with a warm solution of salt and water, for its sedative effect, or of carbonate of soda; then to apply creasote on a pledget of cotton, over which the paste of oxid of zinc and a temporary filling of Hill's stopping are placed, to remain for one or two days; then to remove the temporary filling and, if no pain has been experienced, to permanently fill the cavity.

Where it is desirable to cap the pulps of the temporary teeth, a convex cap of platinum, the concavity of which is filled with the solution of gutta-percha and chloroform, may be applied in such a manner as to avoid pressure, and a Hill's stopping filling inserted over the cap.

The treatment just described refers to pulps free from disease, the condition being primary irritation from exposure and not inflammation from long-continued irritation. In the great majority of the latter cases attempts at preservation prove failures, and when persisted in may prevent any successful subsequent treatment following the extirpation of the pulp. Hence it is necessary to accurately determine the condition of the pulp, when exposed, by a careful examination before treatment is commenced. When the patient possesses a healthy constitution and correct local conditions are present, efforts for the preservation of pulps in more or less unhealthy conditions may be instituted. For example, if effusion of serum or lymph is present the tincture of aconite should be applied to the pulp and also to the gum about the neck and root of the tooth, after which the application of pure carbolic acid to the exposed surface of the pulp, to produce coagulation, is indicated. If such treatment arrests the exudation, which may be determined by drying the parts, then the treatment for a simple exposure of the pulp may be at once instituted, or oxid of zinc made into a paste with water may be applied and the cavity in the crown of the tooth filled with a temporary material. Should the exudation continue, the oxid of zinc, carbolic acid, and oil of cloves paste may be applied to the exposed surface of the pulp, but a loosely introduced pellet of cotton saturated with sandarac should be substituted for the temporary filling, so that the fluids of the mouth may be excluded, but the cavity should not be closed so tightly as to cause trouble by the retention and accumulation of the effusion. When the vessels of the pulp are engorged, depletion by means of an incision, after the application of equal parts of oil of cloves and chloroform, may be made and the pulp be capped by the paste before referred to, over which a pellet of cotton saturated with sandarac may be placed. Such a dressing is allowed to remain for several days, when, if everything is favorable, the permanent capping of the pulp may be made. For purulent discharges from the pulp, after the removal of the irritation, the treatment consists in the application of a mild escharotic in the form of a solution of chlorid of zinc, grs. xxx, water ℥j, for several minutes, after which repeated injections of tepid water should be made and the cavity exposed to the saliva to free the eschar from the chlorid of zinc. The subsequent treatment is the same as that described for effusions of serum and lymph. After capping an exposed pulp the case should be carefully watched, and if there is undue sensitiveness to cold, which is usually the indication of further trouble, the gum about the affected tooth should be bathed with a solution composed of tincture of aconite, ʒij, and chloroform, ʒj. Several applications may be required, although frequently but one is necessary. Another application for the same condition, or in case the former one is not effective, consists of tincture of iodin, fʒij; tincture of aconite, fʒj, and chloroform, fʒj.

CHAPTER IV.

FILLING PULP CHAMBERS AND CANALS OF TEETH.

This operation has now become very common, and is practiced by the most skillful dentists in America and Europe.

Drs. Maynard and Baker were the first to show that most of the morbid phenomena resulting from the presence of a tooth in the mouth after the destruction of the pulp arose from the irritation produced by the matter contained in the pulp chamber and canal of the root. To prevent their occurrence, therefore, they proposed filling both chamber and canal in such a manner as completely to exclude everything else. The accumulation of purulent matter being prevented here, its secretion at the extremity of the root will, in a majority of cases, either cease altogether or go on faster than it is reabsorbed, as has been shown by repeated experiments. Thus it would seem that the amount of vitality which a tooth derives from the investing membrane is sufficient, ordinarily, to prevent it from exerting any apparent morbid action upon the surrounding parts.

Although it is desirable that the operation should be performed before any diseased action has been set up at the extremity of the root, much advantage may also be derived from it, even after alveolar abscess has actually occurred, as great benefit often results from cleansing, disinfecting, and filling the root-canals of teeth which are affected with abscess.

The application of disinfectant and antiseptic agents to the inner walls of the sac, introduced through the canal in the root previously to filling, is one of the most certain means of cure. All root-canals do not require to be drilled out or enlarged, and filled solidly to the apex in order to ensure comfort to the tooth; yet all canals should be sterilized that, owing to their small size and tortuous direction, cannot be filled. Very small and abnormally situated canals can have their openings into the pulp-chamber exposed by flooding this chamber with absolute alcohol and drying it with hot-air. Alcohol will also absorb the moisture from the pulp-tissue remaining in the canals and facilitate its removal. When the openings of the canals have been located, their orifices should be reamed out to such a degree as will indicate the size and direction of the canals. A small, stiff broach should then be employed to explore each canal as far as possible, and when the broach cannot pass beyond a certain point, it may be regarded as conclusive that the caliber of the canal thus explored is so small that no trouble will result from failure to proceed further. An antiseptic should then be pumped well into the canal by flooding the pulp-chamber and forcing on the medicine a piece of soft vulcanite or cotton.

A favorite method of filling root-canals is to first introduce chloro-percha, and after thus lubricating the canal, to force into it, with gentle but constant pressure, a cone of gutta-percha, which the lubricant will soften and thus permit of its easy introduction into and adaptation to the canal. Some prefer a solution of eucalyptol and gutta-percha to the chlora-percha, on account of the eucalyptol being less irritating than the chloroform in the chloro-percha.

Treatment Preparatory to Filling the Canals of Teeth.—The following is a method of treatment, preparatory to filling root-canals, which has for some time been pursued: Carefully remove all disorganized pulp and decomposed dentine; also all softened dentine. Then syringe out all loose particles of the debris with tepid water, and dry the canal to the apex of the root with floss silk, being careful to leave an end projecting, so as to permit its easy removal. Several such pieces being used, a shorter piece is then saturated with pure wood creasote or carbolic acid, and passed to the end of the canal, leaving a slight projecting piece in the crown-cavity, so that it may be seized with pliers when it is to be removed.

Then introduce into the crown cavity a temporary filling of Hill's stopping, gutta-percha, or the zinc preparations. In some cases where the effusion is considerable, and its retention causes discomfort, the temporary filling should consist of cotton, loosely introduced, so that it may be readily removed by the patient if necessary. In twenty-four hours the canal is examined, and the antiseptic agent renewed if necessary. When not the slightest odor of purulent secretion is perceptible, then apply on the floss silk carbolic acid mixed with a little chloroform, replace the filling, and wait for several days.

If at the end of this time there is no trace of diseased action, fill the canal; then wait a few days until all chance of irritation from the pressure used in the operation has passed away, and then complete the filling. But not unfrequently it is necessary to repeat this course of treatment several times.

In some cases it may be prudent to insert a filling of "Hill's stopping" for several months, especially when there is the slightest doubt of the arrest of the disease; for the gold once introduced into the canal, it is exceedingly tedious and difficult to remove it. Disease on the *outside* of the extremity of the root may be controlled by creasote, carbolic acid, or other disinfectants and antiseptics, applied through the fistulous or an artificial opening in the alveolus. (See Alveolar Abscess.)

Chlorid of zinc may be used instead of creasote when the smell of the latter is particularly repulsive to the patient; also, a combination of carbolic acid or creasote and iodin, as Dr. Leech's formula, which is composed of iodin (crystals), ʒj; carbolic acid (crystals), ʒj; alcohol, fʒij, applied on a pledget of cotton or on floss silk; or a saturated solution of iodoform and ether; or eucalyptus combined with iodoform, as Dr. Parmele's formula, which is composed of eucalyptus oil, ʒj; iodoform, gr. x; water, ℥j; or Dr. Black's mixture, composed of carbolic acid one part, oil of cassia two parts, and oil of gaultheria three parts, all of which are excellent antiseptics. Any trace of the living pulp should be treated with some devitalizing agent, which may be introduced upon floss silk before commencing the antiseptic treatment.

The following are the methods of treating pulpless teeth pursued by Prof. Gorgas and others:—

The temporary or deciduous teeth should be retained for their full natural term, and if from any cause their pulps become diseased before such a period, the first thing to be done is to open the pulp chamber. Should such a tooth be painful to the touch, it should not be further operated on until the soreness has disappeared. Then the cavity of decay should be thoroughly cleansed, the dead pulp removed, and a pellet of cotton, saturated with such a solution as the following: Carbolic acid (5 per cent. solution) ℥j, cinnamon or peppermint water gtt. lx, placed in the pulp-chamber and covered with a pellet of dry cotton or soft rubber (such as a piece of rubber-dam). Pressure should then be made upon the cotton or rubber with a blunt instrument until the fluid appears at the fistulous opening, if one exists. The cotton or rubber should then be removed, the crown-cavity and root-canals dried, then by means of a small pellet of cotton wound on a broach, a solution of gutta-percha in chloroform, of the consistence of cream, should be forced into the root-canals, after which the canals should be filled with gutta-percha cones, which may be easily introduced owing to the solvent action of the chloroform already in the canals.

Pulpless deciduous teeth without fistulous openings are treated in the same manner as permanent teeth with blind abscesses.

In cases of the permanent teeth where it is necessary to devitalize the pulp, the rubber-dam should first be adjusted, the carious cavity freely opened, and all loose matter and softened dentine removed, so that the pulp is freely exposed. A small pellet of cotton is then dipped in pure wood creasote, and $\frac{1}{40}$ or $\frac{1}{50}$ of a grain of the oxid of arsenic taken up on it and placed directly in contact with the exposed point of the pulp, and the crown-cavity carefully sealed in such a manner by a temporary filling as not to cause any pressure on the pulp. This preparation of arsenic should be permitted to remain for 24 hours, when it should be removed and the cavity carefully washed out. After the removal of the devitalized pulp, access to which is made by freely opening the root-canals, the drills employed for this purpose being frequently dipped into eugenol, or a 5 per cent. solution of carbolic acid, or other disinfectants and antiseptics, such as oil of cassia and wintergreen, or a solution of bichlorid of mercury—$\frac{1}{500}$ or $\frac{1}{1000}$—or peroxid of hydrogen, or peroxid of sodium. The use of sulphuric acid is also recommended for opening the pulp-canals (page 559). The root-canals should be thoroughly disinfected by any of the agents just mentioned and permanently filled with the gutta-percha cones or the zinc filling materials.

For the treatment of pulpless teeth affected with blind abscesses, the rubber-dam should first be adjusted, the main cavity of decay excavated, and all softened dentine removed. The pulp-chamber should be opened thoroughly and well syringed with tepid water. The root-canals should then be opened and carefully syringed with an antiseptic solution, then thoroughly dried and injected with peroxid of hydrogen until all bubbling ceases; peroxid of sodium (50 per cent. solution) may also be injected into the root-canals and into the apical space, or they may be bathed with eugenol, or with oil of cassia, carbolic acid, and wintergreen, or with oil of cassia and guaiacol, or carbolic acid (5 per cent. solution), or pure wood creasote, when the crown-cavity is loosely filled with dry cotton. After three days this treatment should be repeated, and continued at the same intervals until it is quite evident that the discharge of pus has ceased. When such is the case the root-canals should be tightly packed or well saturated with one of the disinfecting combinations before referred to, and the crown cavity filled with a temporary filling material, and the tooth permitted to remain at rest for four or five days. After this time, if no soreness is apparent on percussion or pressure, or any evidence of pus is apparent on removing the temporary filling, the canals should be thoroughly dried and permanently filled with gutta-percha or other root-canal filling material. The vapor of crystals of iodin forced into the apical space with a hot-air syringe constructed for such a purpose has also given satisfactory results in cases of blind abscess, as well as those with fistulous openings.

Dr. C. N. Johnson's method of treating pulpless teeth with no fistulous openings is as follows:—

The rubber-dam should be applied before any drilling is attempted, and an antiseptic (such as carbolic acid one part, oil of cassia two parts, and oil of gaultheria three parts) placed near at hand for immediate use the moment the pulp-chamber is penetrated. This antiseptic should be non-irritating and non-effervescing, in order that no septic matter in the canal be forced into the apical space. As soon as the chamber is reached by the drill, it should at once be flooded with the antiseptic, care being taken not to cause any pressure upon the contents of the canal. After a little time a bit of absorbent cotton or bibulous paper may be lightly applied to the opening to absorb enough of the antiseptic to admit of drilling to enlarge the opening, and when this is done the chamber may repeatedly be flooded, and the contents absorbed as before, till the greater part of the putrescent matter has been removed from the chamber and greater portion of the canals without causing disturbance at the apical foramen. When this process has been carried to the limit of safety, the cavity is flooded with absolute alcohol for its dehydrating effect, and this evaporated to dryness. The dryer the canals the less chance there is for micro-organic life to exist, and when an antiseptic is applied the greater will be the amount taken up by the tubuli. The crown of the tooth, however, must not be heated too hot in the process of drying the root, nor should it be kept dry too long for fear of injury through the checking of the tooth-structure. When dryness of the canals is obtained, they should once more be flooded with an antiseptic, this time to remain sealed in the cavity until the next sitting. The canals are left thus filled, but no cotton is forced into them at this time. A small pledget of cotton may be placed loosely in the chamber, and the opening closed with gutta-percha. The case may then be dismissed for one week, with instructions to return sooner in case of trouble. If in any doubt, the patient should be seen in 24 or 48 hours, and the dressing changed. At the end of the week, if no symptoms of irritation have been felt, and if the canals show no signs of putrescent matter on the removal of the dressing, the roots may be filled, first, however, washing them out with alcohol, drying them, flooding with the antiseptic, and finally drying. In case, however, after the first treatment the dressing should show signs of a blind abscess in the apical space, the treatment should be continued till all weeping of pus stops and the abscess heals.

Management of Pulpless Teeth with Fistulous Opening.—First, the soft decalcified dentine should be cleansed from the cavity and the pulp-chamber thoroughly opened, the putrescent contents of the canals removed as thoroughly as possible, and to accomplish this the chamber and canals should be flooded with an antiseptic, and this absorbed with cotton or bibulous paper. When the canals are cleaned the abscess should be injected with the antiseptic through the canal, and the process kept up, if possible, till the medicine appears at the fistulous opening on the gum. This may be done by packing the canal tightly with cotton saturated with the medicine, and then forcing down upon it a mass of soft rubber such as is used for packing plates of dentures. When the medicine appears at the fistulous opening, if the case is one of recent occurrence, the cavity may at once be sealed—after replacing the cotton in the canal with freshly saturated cotton—and the patient dismissed for one week. If the case is one of long standing, where the dentine of the root is much infected, it is best after the injection to flood the canal with alcohol and evaporate to dryness before applying the antiseptic and sealing the cavity. This insures a more thorough saturation of the tubuli with the antiseptic, and the tooth will return to a better condition than if the drying had been omitted. When the patient returns, and the fistula is found perfectly closed, the root may be filled at this sitting, the same process being followed prior to filling as that advised in the case of roots without fistulous openings. If the patient returns with the fistula still discharging, carbolic acid (95 per cent. solution) is injected till it appears at the fistulous opening. The canal is then packed with cotton saturated with carbolic acid, the cavity sealed, and the patient dismissed. If there has been much discharge with a free opening, pyrozone (3 per cent. solution) may be injected prior to the use of carbolic acid. Seal such a case for a week, and repeat the treatment if the fistula is found open at the end of that time. In chronic cases, where a third treatment has been found necessary, the dressing in the canal should not be disturbed for a month. The operator may see the patient in the meantime, and if he deems it necessary may treat the fistula through the opening, but in very many of these cases no treatment at all is preferable to any treatment.

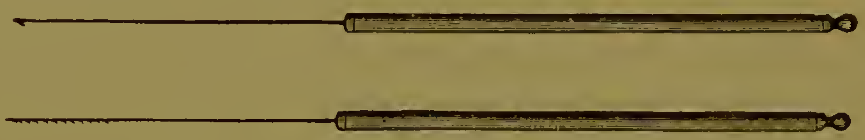


FIG. 509.

The immediate filling of the root-canal in such cases has also been recommended. (See Low's Method, page 561.)

Fig. 509 represents iridio-platinum nerve broaches for extracting dead pulps of teeth and for introducing into the pulp-canal medicinal agents in the treatment of diseased teeth. They do not corrode when exposed to moisture, acids, iodin, etc., and can be cleansed perfectly by heating to redness in the flame of a spirit lamp.

Fig. 510 represents a set of Dr. B. F. Arrington's devitalized nerve extractors and canal pluggers, of drawn and spring temper.

Fig. 512 represents Dr. Donaldson's spring-tempered nerve-bristles and pulp-canal cleansers.

Fig. 513 represents Dr. Walker's nerve-canal drills.

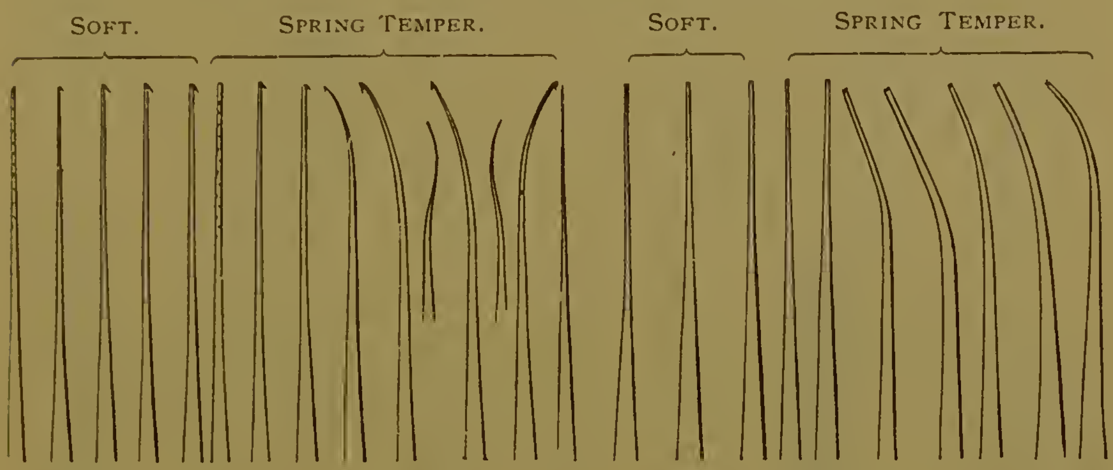


FIG. 510.

Filling Pulp Chambers and Canals of Teeth.—For filling pulp canals very nice instruments may be made from piano wire filed to any desired size and fitted into suitable handles. This wire is very tough and elastic. The gold used for filling pulp canals should be non-cohesive and folded into a very light ribbon, and this cut into square pieces, which should be placed upon a piece of folded chamois skin and carried to the pulp canal by means of the nerve-canal plugger point. Piece after piece of the gold is carefully introduced to the apex or upper extremity of the root until the entire canal is filled. Strips of heavy gold foil conveyed to the apex of the canal in a similar manner, or by mallet force, are also employed for filling root canals. Malleting the gold into the canals is also preferred by many to pressure with the

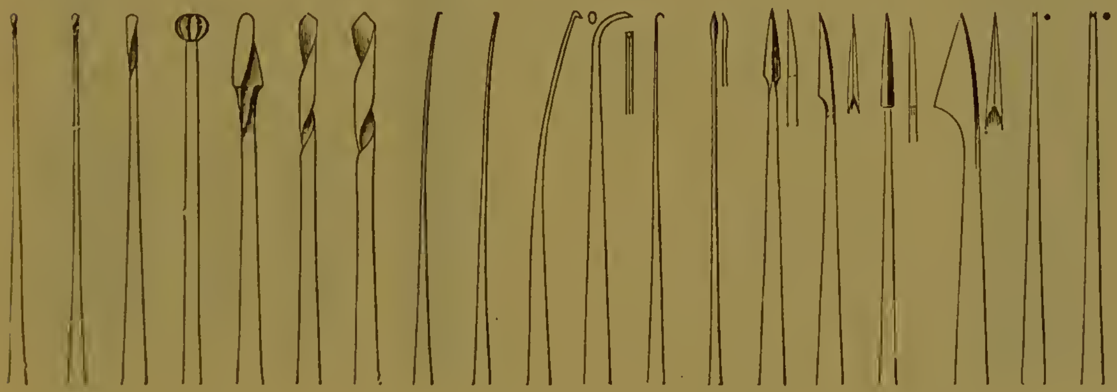


FIG. 511.

hand, as percussion causes no deflection of the instrument such as may occur under pressure with delicate canal pluggers. The cavity in the crown is then filled in the usual manner.

Fig. 511 represents a set of nerve instruments contrived by Dr. Corydon Palmer for entering and enlarging the canals in the roots of the teeth.

Fig. 514 represents Dr. Hunter's set of pulp-canal pluggers, some of which are of drawn and others of spring temper.

After the cavity of decay in the crown has been properly prepared by means of the instruments represented in Fig. 512, the pulp chamber can be excavated and so shaped as to assist in the retention of the gold. Some operators drill out these canals and thus give them the same diameter from their orifice at the pulp chamber to the apex of the root, but this is considered by many to be an unnecessary as well as dangerous operation, as the instrument may pass through the side of the root, particularly where the root happens to be curved. Reaming out and enlarging the orifice of the canal may be sufficient in the majority of cases.

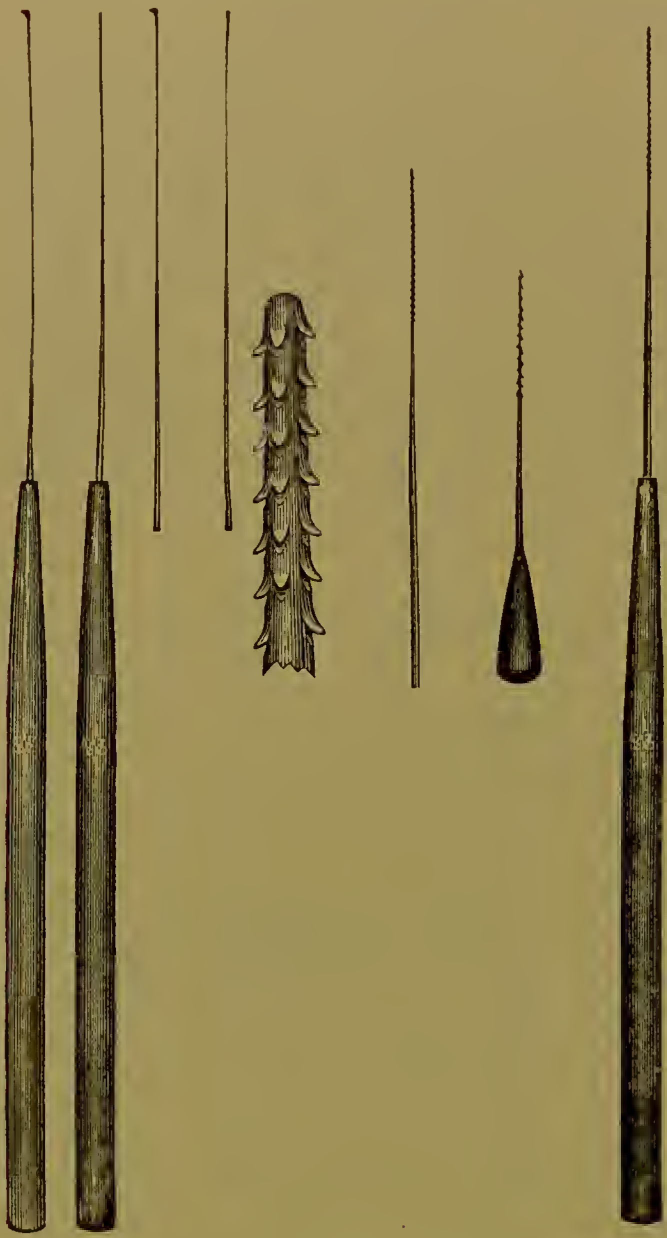


FIG. 512.

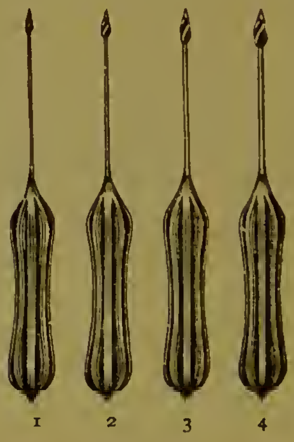


FIG. 513.

Others are satisfied with cleansing them perfectly of all debris and decomposed dentine, and thoroughly disinfecting them and rendering the contents of the tubuli aseptic. Whichever method is pursued, care is necessary that the instrument is not passed beyond the foramen, which is more liable to occur in the case of young patients, when the teeth are not fully developed, than afterward; for in adult teeth there is generally such a decided contraction of the root canal near the apex as to arrest the progress of the instrument.

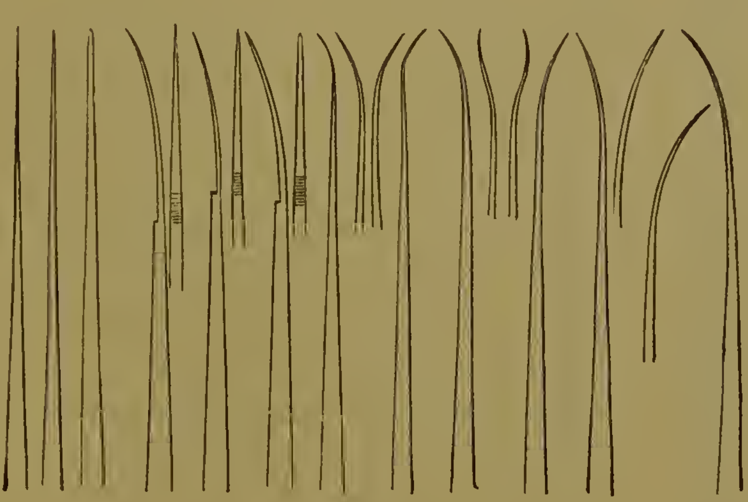


FIG. 514.

Figs. 515 and 516 represent sets of nerve-canal drills and reamers, devised for the enlargement of the canals prior to the filling of the same, and also for pivoting.

For facility of treating and filling, free access, however, should be had into root-canals by means of the instruments referred to. Recently the use of a 40 or 50 per cent. aqueous solution of sulphuric acid has been employed for opening root-canals. This process is described as follows by Dr. J. R. Callahan: "Adjust the rubber-dam, open the pulp-chamber thoroughly,

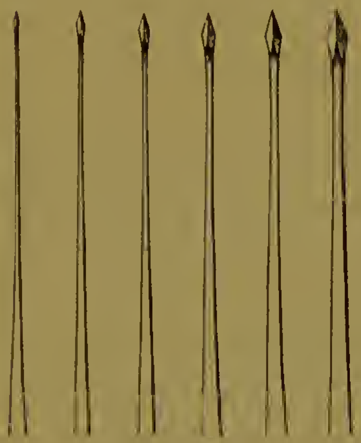


FIG. 515.

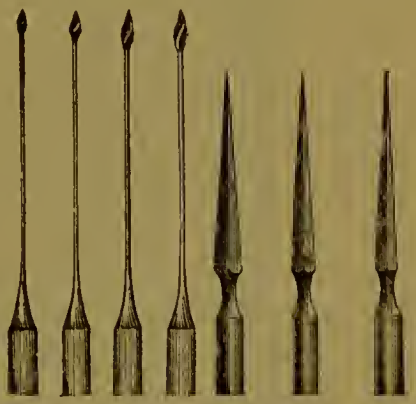


FIG. 516.

twist a little cotton on the end of a broach, bend the broach to a right angle, so that it will reach well down into the cavity; place the broach in a suitable handle, and by means of broach and cotton place upon the dead pulp a drop or two of the sulphuric acid solution, which, by a process of dehydration, will cause the pulp to shrink and toughen, when it can be easily removed. By the broach and cotton, a drop of the solution is placed over the entrance to each canal, then with a pumping motion enter the canal slowly and carefully; the acid will destroy all septic matter and enlarge the diameter of the canals. By means of a syringe the root canals are then filled with a saturated solution of bicarbonate of soda, which will neutralize the acid and liberate carbonic acid gas in such quantities that the effervescence will carry all the broken-up tooth- and pulp-substances out of both the canal and tooth, leaving a deposit of bicarbonate of soda, which can be removed by a little sterilized water, alcohol, or peroxid of hydrogen. The roots can then be filled if no inflammatory symptoms are present."

Besides the method of filling the roots described above, there are several others, one of which consists in rolling strips or folds of gold on a fine broach in such a manner as to form cone-shaped cylinders, somewhat longer than the canal is deep, of different sizes and density. The soft rolls are first introduced on a smooth broach, or, if the canal is large and easily approached, by means of the pliers, and carried up as near to the apex of the root as is possible, each one being condensed as it is introduced. Successive cylinders are introduced in this manner and condensed until the canal is filled, the last ones, which complete the filling, being larger, of heavier gold, and more densely rolled. Pure gold or platinum wire is sometimes employed for filling these canals, so shaped as to correspond in size and taper with the cavity. These wires should be coated with gutta-percha or oxyphosphate of zinc before introducing them.

It sometimes happens that the canals in the buccal roots of the superior molars are so small as to preclude the introduction even of a small-sized bristle. In cases of this kind it is impossible to fill them, and fortunately, from their small size, they cannot serve as reservoirs for the accumulation of morbid matter. Such canals, however, should be thoroughly disinfected before the larger ones are filled. The canal in the palatine root is always much larger than in either of the buccal roots, and in a majority of the cases is filled with comparative ease. Although gold and tin have long been used for filling root canals, yet some non-metallic substances have answered well when employed for this purpose, such as cones of gutta-percha, chloro-percha, gutta-percha and eucalyptol, Hill's stopping, and the zinc filling materials. When cones of gutta-percha are used for filling pulp-canals one end of the cone is dipped in chloroform, which softens it and facilitates its introduction and adaptation to the canal. Gold may be employed for filling the space of one-third of the canal from the apex, and the remaining portion may be filled with gutta-percha or oxyphosphate of zinc. Amalgam has also been employed for filling root-canals. An instrument represented by Fig. 517 is the invention of Dr. Geo. Evans for drying root canals preparatory to filling them. The oval mass of copper is heated in the flame of the lamp to a dull red, and the heat passes rapidly along the silver probe, which is inserted as far up the canal as possible. The effect is to evaporate the moisture and gases and carbonize any organic material in the canal and tubuli. For bleaching teeth which have become discolored from loss of vitality, the reader is referred to the chapter on that subject.

In the treatment of the canals of devitalized teeth, if there is a secretion of liquid (protoplasm) through the foramen into the pulp canal, bibulous paper or absorbent cotton may be employed for drying the canal, when chlorid of zinc in a deliquesced form should be introduced on cotton wound about a broach, which will coagulate the fluid emanating from the elements of the tissues about the apex of the roots, and the canal can at once be permanently filled. A putrescent pulp remaining in the root canals gives rise to the formation of sulphureted and phosphoreted hydrogen gas from the disintegrating tissue, which, with the particles of such tissue and the foreign matter forced through the foramen, causes irritation of the tissues surrounding the apex of the root. The secretion of pus will continue as long as the putrescent matter remains in the canal and the mephitic gas evolves from it through the apical foramen, and relief is experienced only when the suppurating surface is destroyed and a normal action brought about by removal of the irritating matter and the action of an escharotic or disinfectant, such as carbolic acid or creasote, iodoform, eucalyptus, peroxid of hydrogen, etc., assisted by injections of warm water as a cleansing process.

The method of "immediate root-filling" is described by Dr. Frank W. Low as follows:—

"The instruments best adapted for general use,

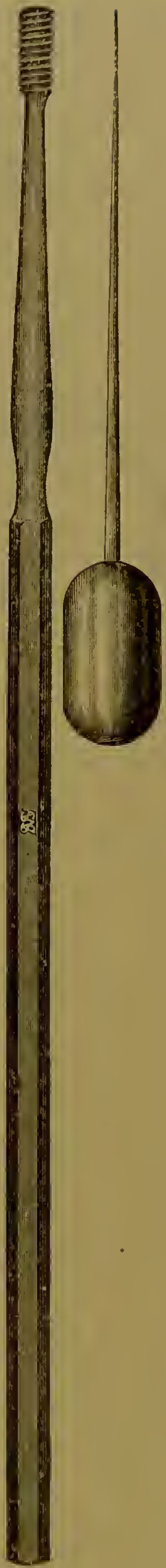


FIG. 517.

especially in the deeper portions of the pulp canals, are Donaldson's spring-tempered pulp-canal cleansers. First, because, if they penetrate a root in which is present a sloughing and partly disorganized filament of the pulp, they seem to cause less pain than barbed broaches, and are more likely to so engage the fibre as to bring it away entire. Second, in the absence of any sensitive filaments the debris is removed rapidly, engaging itself in the screw threads of the instrument its entire length, from which it can be readily removed when withdrawn by brushing with an ordinary tooth-brush. Third, because if it is found, when screwed into the canal, that it will not *strip* out—thus bringing its load—it can be safely and easily disengaged by turning to the left, as you would remove any other screw-threaded instrument. Fourth, because the worn-out instruments are of such fine temper that they can be ground on the lathe corundum wheel into four or five-sided broaches, and as such can be utilized to wrap minute shreds of absorbent cotton upon for the final drying process before the gutta-percha cones are introduced. Several of these can be wound, even by an inexperienced assistant, and thus be ready at once for rapid successive introduction just preceding that of the cones.

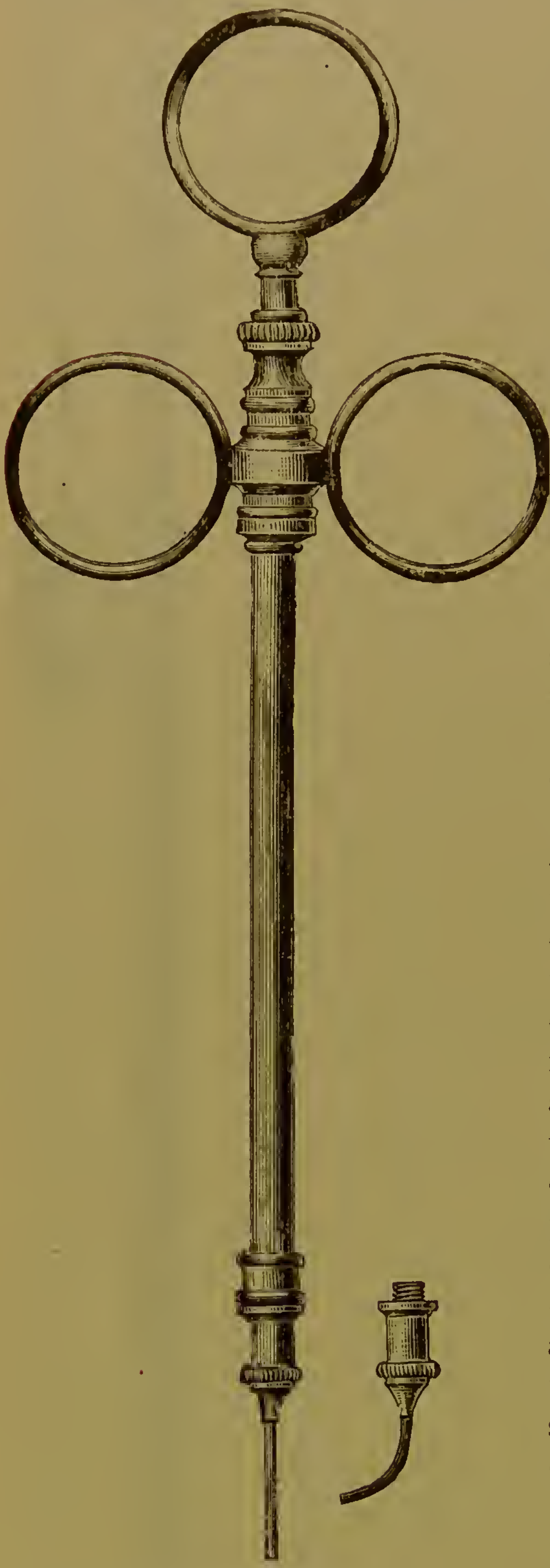


FIG. 518.

"The penetration of canals will be accelerated by frequent injection of peroxid of hydrogen, because of the expulsion of their contents, incident to the effervescence of this compound, as well as its chemical combination with and consequent softening of the products of infection present.

"When the instruments have at length penetrated the apex of the root—of which fact you may safely trust the patient to make you aware—it will often be found upon injecting the peroxid solution once more that effervescence (which perhaps just before had nearly or quite ceased) will again manifest the presence of septic matter; this, however, is caused by the pus so often confined in the 'apical space,' and any further penetration of the broach is contraindicated. It is not sufficient merely to inject in order to obtain the full benefit of the peroxid in this new territory of infection, but the plunger of the syringe should be worked with a rapid churning motion for several seconds, while the nozzle of the instrument remains as deeply fixed as possible in the pulp canal under treatment, for by this reciprocating motion of the plunger the fluid is forced beyond the apex of the root and into the infected territory, and thoroughly mixed with any pus which may then be present.

"An instrument well adapted for the purpose of thus injecting the peroxid of hydrogen is the Lewis abscess syringe (Fig. 518). The advantages to be derived from its use are that it can be operated with one hand and the pumping or churning motion above mentioned be easily accomplished. The capacity of the syringe is so small that the injecting process is prevented from becoming a sloppy one, while at the same time the fit of the plunger is so perfect that the injection is accomplished with considerable force.

"When effervescence again ceases—which will be indicated if, upon removal with cotton or spunk of all the 'lather' previously made, it is found that further injection produces only such bubbles as may be expected from the confinement of particles of air in any liquid—the canal should be wiped out and an injection of the $\frac{1}{1000}$ bichlorid of mercury solution substituted. It is just possible that the use of the bichlorid solution might be dispensed with; but it is the most powerful known germicide, and besides it is just sufficiently irritant to cause the inner walls of the abscess—if one be present—when collapsed, to become obliterated by adhesion.

"To facilitate this collapse of the walls of the pus sac, the syringe again comes into use as an aspirator. The use of the dry hot air current is next indicated, and last of all the little broaches wound with cotton shreds. Several of these latter should be used, even though the first one withdrawn appears to be dry, because they are the most perfect exhaust plungers after all. Following their use, the canals should be quickly sealed with gutta-percha cones dipped in a thin chloropercha solution to facilitate their deep penetration into the canal and at once to varnish them tight to its walls. A moment's wait—which usually is gratefully accepted both by operator and patient—is now advisable in order that the chloroform of the chlora-percha, which, as the cone descends into the cavity of the canal, will be found to have regurgitated, may have an opportunity to evaporate. After wiping this off with spunk or cotton, the cone will be found very soon to be dry, and then it can be condensed a trifle, after which, if the material to be used be other than gold, the crown filling can safely be made at once.

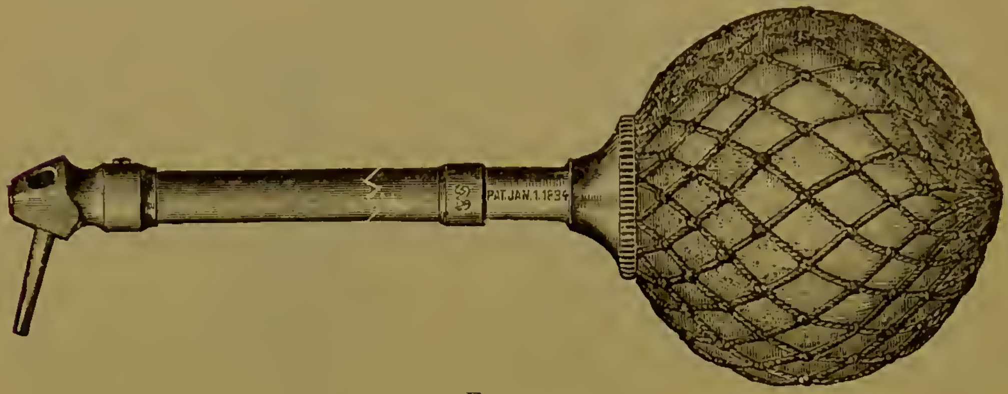


Fig. 519.

"If gold is to be the material used, the operation had better be deferred for a few days, lest the impact of the plugger should cause acute inflammation of the irritable peridental membrane."

Another convenient syringe is the Laskey (Fig. 519), from which an obstruction of the discharge-pipe can be readily removed.

CHAPTER V.

EXTRACTION OF TEETH.

There are few operations in surgery that excite stronger feelings of dread, and to which most persons submit with more reluctance, than the extraction of a tooth. Many endure the torture of toothache for weeks, and even months, rather than undergo the operation; and, indeed, when we take into consideration the frequent accidents occurring in its performance by awkward and unskillful individuals, it is not surprising that it should be approached with apprehension. But when performed by a skillful hand and with a suitable instrument, the operation is always safe, and in a large majority of the cases may be effected with ease.

Numerous cases of serious injuries show the impropriety and danger of intrusting this operation to individuals possessing neither knowledge of its principles nor skill in its performance. Injuries occasioned by the operations of such persons have frequently come under the immediate observation of the author, with whom it has always been a matter of surprise that an operation to which such universal repugnance is felt should ever be confided to them.

The removal of a wrong tooth, or of two or three instead of one, are such common occurrences that it were well if the precautions given by the illustrious Ambrose Paré were more generally observed. So fearful was he of injuring the adjacent teeth, that he always isolated the tooth to be extracted with a file before he attempted its removal. He regarded it as of the greatest importance that a person who extracted teeth should be expert in the use of his "tooth mullets; for unless he knows readily and cunningly how to use them, he can scarcely so carry himself but that he will not force out three teeth at once." Although great improvements have been made since his time in the construction of extraction instruments, yet even now the accidents to which he alluded are of frequent occurrence.

It is surprising that an operation so frequently called for should receive so little attention from medical practitioners, by whom, though not strictly belonging to their province, it must frequently be performed. This neglect can only be accounted for by the too general prevalence of the idea that little or no surgical skill is necessary to its performance. But every physician residing in the country, or where the services of a skillful dentist cannot always be commanded, should provide himself with the proper instruments, and make himself acquainted with the manner of performing this operation.

INDICATIONS FOR THE EXTRACTION OF TEETH.

With regard to the indications that determine the propriety of extraction, the author does not deem it necessary to say much in this place, as they are fully pointed out in other parts of the work. It may be well, however, to briefly mention, in this connection, a few of the circumstances which call for the operation.

Beginning with the teeth of first dentition, it will be sufficient to state that when a tooth of replacement is about to emerge from the gums, or has actually made its appearance, either before or behind the corresponding deciduous tooth, the latter should at once be removed; and when the aperture formed by the loss of this is so narrow as to prevent the former from acquiring its proper position, it may sometimes be necessary to extract an adjoining temporary tooth. For more explicit directions upon this subject, the reader is referred to the chapter on Second Dentition. Alveolar abscess, necrosis of the walls of the alveolus, and pain in a temporary tooth which cannot be cured by any of the usual remedies, may be regarded as indications which call for the operation.

The principal conditions which should determine the extraction of a permanent tooth may be enumerated in the following order:—

First, when a molar, from the loss of its antagonizing tooth, or from other causes, has become partially displaced, or is a source of constant irritation to the surrounding parts.

Second, a constant discharge of fetid matter from the pulp cavity through a carious opening in the crown. There may, however, be circumstances which would justify a practitioner in permitting or even advising the retention of such a tooth, as, for example, when the discharge of fetid matter is not very considerable; also, where the tooth is situated in the anterior part of the mouth, and cannot be securely replaced with an artificial substitute. The secretion of fetid matter may in some cases, by judicious treatment, be arrested, the tooth preserved for many years by filling, and so the morbid influence it would otherwise exert upon the surrounding parts may be counteracted. A front tooth should not be sacrificed unless called for by some very urgent necessity; neither should an upper incisor nor cuspid be permitted to remain in the mouth if it exerts a manifestly morbid action upon the surrounding parts, for in this case the consequences resulting from its retention in the mouth may be worse than the loss of the tooth.

Third, a tooth which is the cause of an incurable alveolar abscess should not be permitted to remain; but if it be an incisor or cuspid, and the discharge of matter through the gum is small, occurring only at long intervals, and especially if the organ cannot be securely replaced with an artificial substitute, it may be permitted to remain. An incurable abscess in the socket of a bicuspid or molar should always be considered as a sufficient indication for the removal of the tooth.

Fourth, irregularity in the arrangement of the teeth, arising from disproportion between the size of the teeth and the size of the alveolar arch, usually requires for its correction the extraction of some one or more teeth. But with regard to the teeth most proper to be removed the reader is referred to the chapter on Irregularity, where he will find full directions for the management of such cases.

Fifth, all dead teeth and roots of teeth which act as irritants, and teeth which have become so much loosened, from the destruction of their sockets, as to be a constant source of disease to the adjacent parts, or teeth otherwise diseased that are a cause of neuralgia of the face, disease of the maxillary sinus, dyspepsia, or any other local or constitutional disturbance, such teeth should, as a general rule, be extracted.

There are other indications which call for the extraction of teeth, but the foregoing are among the most common; they will be found sufficient in most instances to determine the propriety or impropriety of the operation. Cases are, however, continually presenting themselves to which no fixed rule would be found applicable, and where an experienced judgment alone can determine the practice proper to be pursued.

In conclusion, it is scarcely necessary to say that whenever a tooth can be restored to health it should always be done; but tampering with such as cannot be rendered healthy and useful, and which, by remaining in the mouth, exert a deleterious influence, not only upon the adjacent parts, but also upon the general health, cannot be too strongly deprecated.

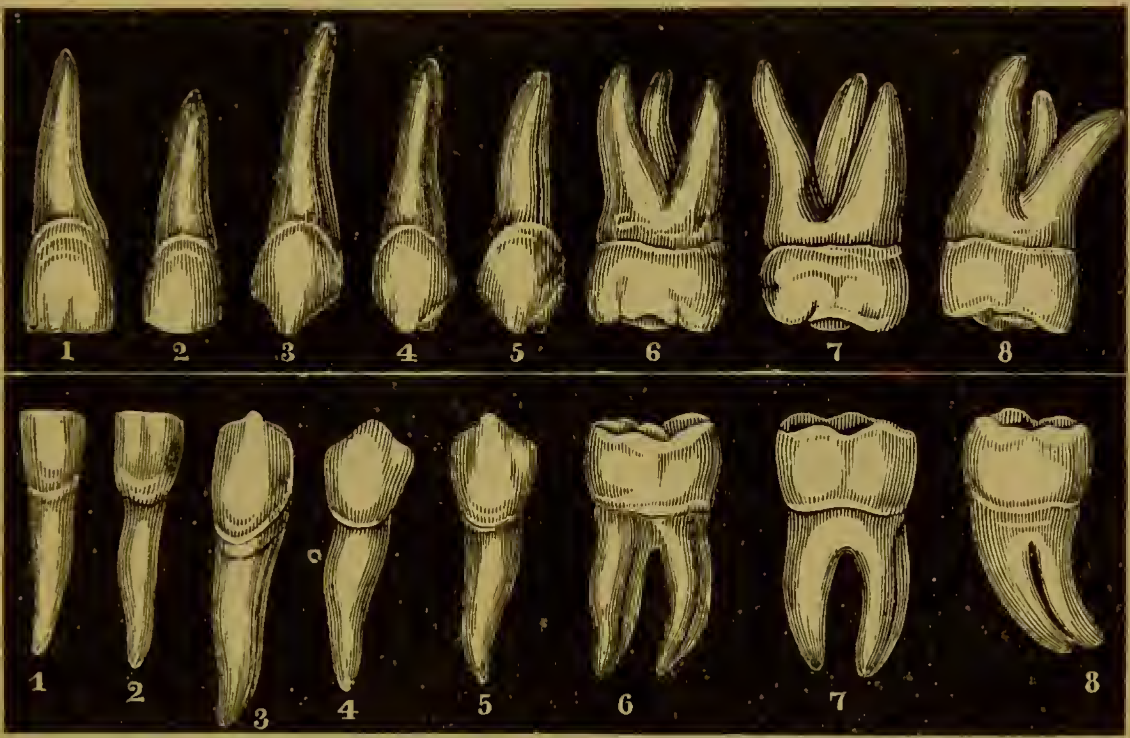


FIG. 520.

Fig. 520 represents the permanent teeth of the left side, a study of which will enable the student to form a correct idea concerning crowns and roots of the different classes of teeth.

INSTRUMENTS EMPLOYED IN THE OPERATION.

Different operators employ different instruments. For about fifty years the key of Garengeot was almost the only instrument used in the performance of the operation; but this has in a great measure been superseded by forceps, which, when properly constructed, are far preferable; yet as the key is still used by some, a brief description of it is here given.

Key Instrument.—"The common tooth-key," says Dr. Arnot, "may be regarded in the light of a wheel and axle, the hand of the operator acting on two spokes of the wheel to move it, while a tooth is fixed to the axle by the claw and is drawn out as the axle turns. The gum and alveolar process of the jaw form the support on which the axle rolls."

Different dentists have their keys differently constructed, but the principle upon which they all act is precisely the same. Some prefer the bent shaft (Fig. 521), others the straight. Some give a decided preference to the round fulcrum, others to the flat; and though the success of the operator depends greatly upon the perfection of the instrument, yet he may remove a tooth more expertly by means of a key with which he is familiar than by one to which he is unaccustomed, though its construction be even better. Fig. 521 represents a key with bent shaft and two hooks, one for molars and the other for bicuspids.

The principle of action of the key is, in fact, not unlike that of a nail drawer or tack puller, and may be adapted to a certain class of cases, namely, where one wall, either the inner or outer, is decayed below the alveolus, while the opposite one is still standing. The fulcrum, with a folded napkin or other soft substance interposed, is placed against the gum on the side of the tooth most decayed and the hook adjusted to the neck of the tooth on the opposite side. With the improved forms of forceps now in use, teeth can be extracted with greater facility, less pain to the patient, and also with less risk of fracture than is possible with the key instrument; hence, the latter is rarely employed at the present time.

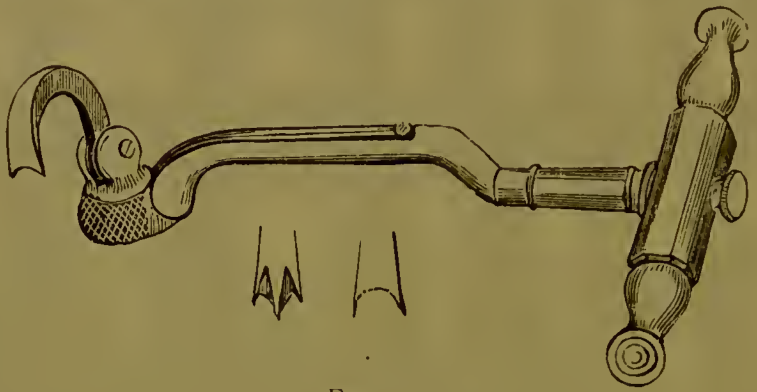


FIG. 521.

Forceps.—Forceps were not very generally or extensively employed, except for the extraction of the front teeth, until about the year 1830; but the improvements made in their construction since that period are so great that their use has now, among dentists, superseded that of the key.*

---

* To Prof. Chapin A. Harris is due the credit of having devised the first improved set of forceps for the extraction of teeth, of which many of the later inventions are modifications.

In order that forceps may be used with ease, it is necessary they should be properly constructed. Every operator should possess a number of pairs (nine at least), each with a differently shaped beak adapted to the necks of the teeth to which they are respectively designed to be applied.

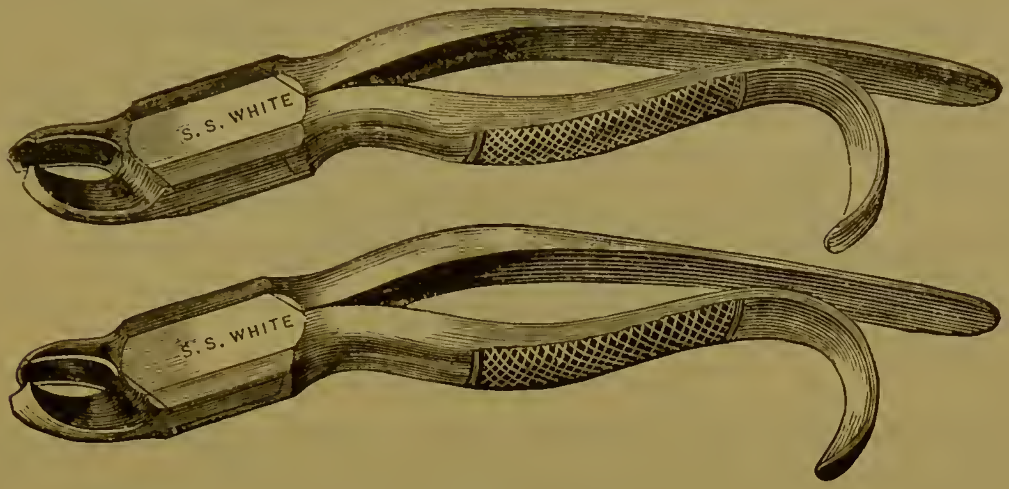


FIG. 522.

For the upper molars two (Fig. 522) are required, one for each side, curved just below the joint, so that the beak shall form an angle of twenty or twenty-five degrees with the handles, just enough to clear the lower teeth. The inner blade is grooved to fit the neck of the palatine root; the outer blade has two grooves, with a point in the center to fit the depressions just below the bifurcation of the two buccal roots. Another valuable improvement consists in having one of the handles bent so as to form a hook. This passes round the operator's little finger, to prevent the hand from slipping.

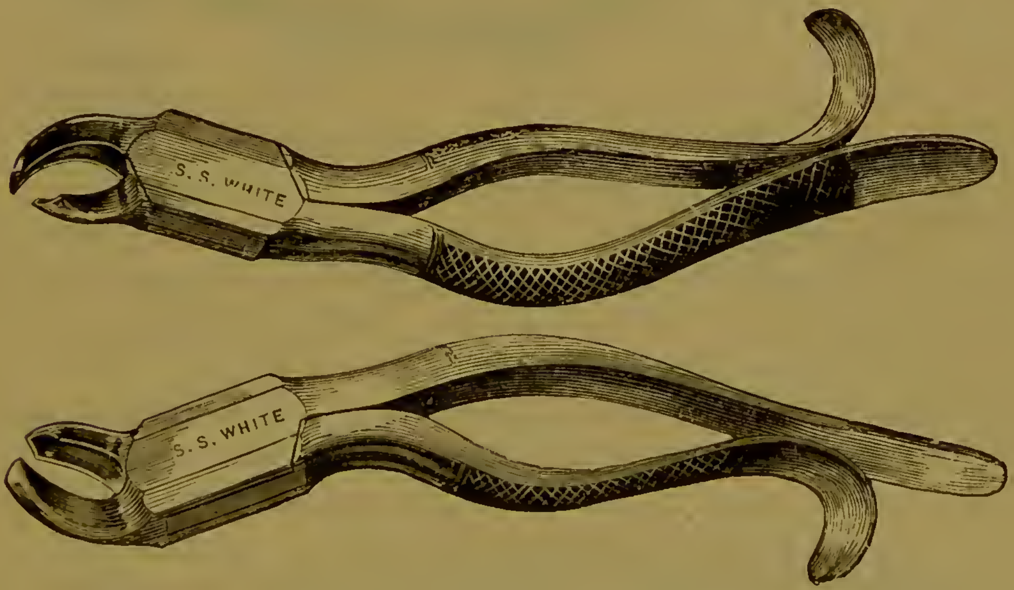


FIG. 523.

Fig. 523 represents another form of superior molar forceps, right and left, with a greater curvature in the handles than the C. A. Harris pattern, which some consider an improvement.

The handles of forceps should be wide and large enough to prevent them from springing under the grasp of the hand, to which they should be accurately fitted, and the ends of the straight handles should be thick and rounded to prevent injury to the palms of the hands. For the comfort of the fingers, the inner corners of the handles should also be rounded. Every dentist, therefore, in having forceps manufactured, should give special directions with regard to their shape and size. The beak should be bent no more than is absolutely necessary to prevent the handles from coming in contact with the teeth of the lower jaw; for in proportion to the degree of curvature will the muscular power of the operator be disadvantageously exerted.

Each blade of the beak of the lower molar forceps has two grooves, with a point in the center so situated that in grasping the tooth it comes between the two roots just at the bifurcation. An improvement made by Prof. C. A. Harris in 1833 consists in having the handles of the instrument so bent that it may be as readily applied to one side of the mouth as the other, while the operator occupies a position to the right and a little behind the patient. By this improvement the necessity for two pairs is superseded; it, moreover, enables him to control the head of the patient with his left arm and the lower jaw with his left hand, rendering the aid of an assistant wholly unnecessary.

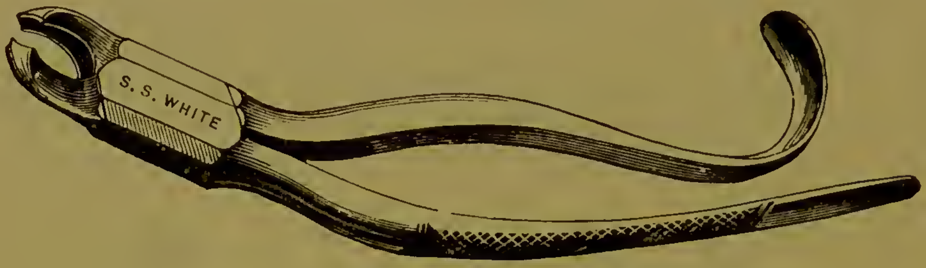


FIG. 524.

The shape of the instrument as improved by the author is shown in Fig. 524. It is now used by many hundreds of operators, who prefer it to any other instrument they have ever employed. When applied to a tooth the handles turn toward the operator at an angle of about twenty-five or thirty degrees. Without this curvature in the handles the arm of the operator would often be thrown so far from his body as to prevent the proper control over the instrument. It is also important that the handles should be wide and accurately fitted to the hand. The inferior dentes sapientiæ can also, in the majority of cases, be removed with this form of forceps.

Fig. 525 represents Wolverton's inferior molar forceps for either side, with longer points in the center of each blade of the beak, which answer a good purpose where the roots slightly diverge and admit the points within the bifurcation.

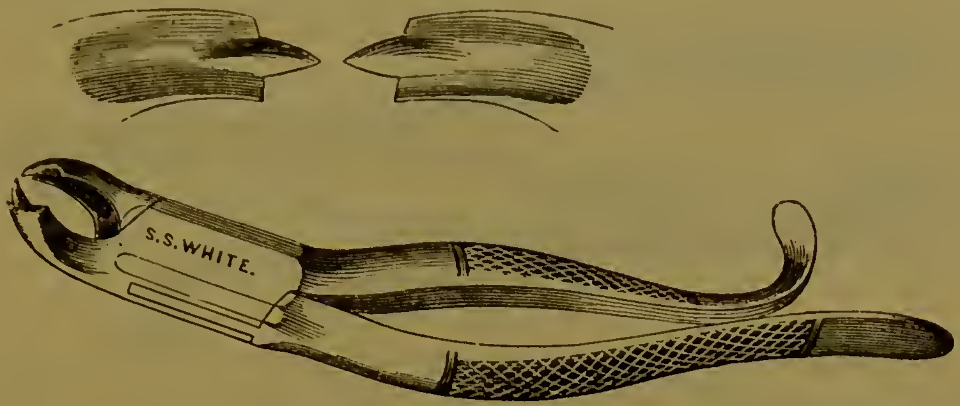


FIG. 525.

Fig. 526 represents inferior molar forceps for the right and left sides of the mouth, which some prefer to the single forceps on account of the position of the hand grasping the instrument.

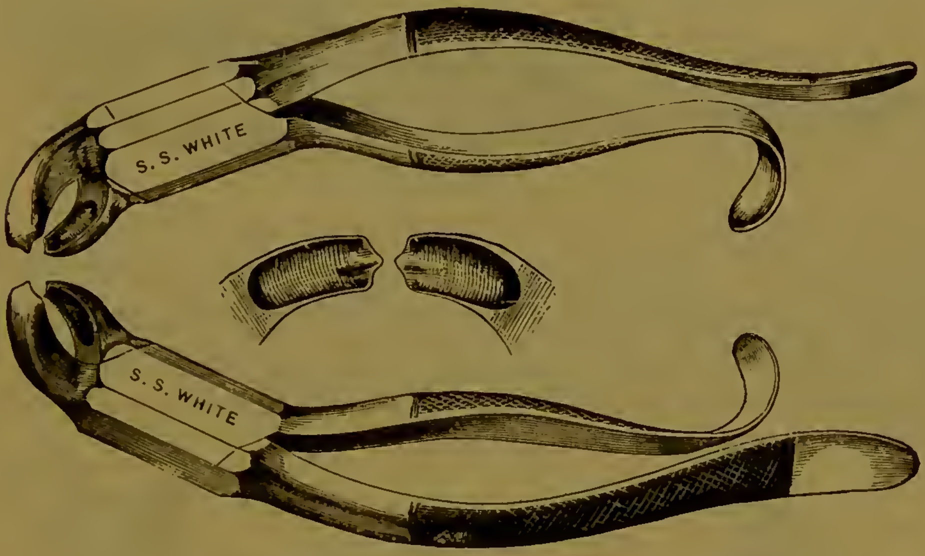


FIG. 526.

Fig. 527 represents a lower molar forceps with plain beaks, for use on either side, intended more especially, however, for the inferior third molars.

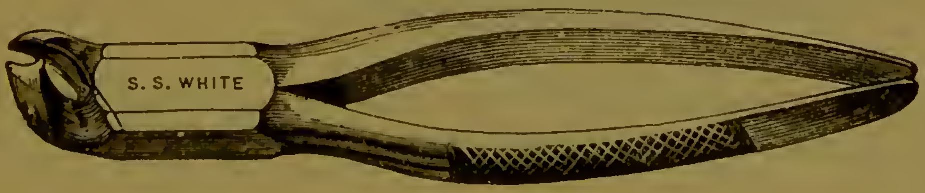


FIG. 527.

For the extraction of the upper incisors and cuspids one pair only may be used, although an instrument with the inner concave beak somewhat narrower than the outer conforms more nearly to the shape of the necks of the superior cuspids, and is preferred by many for the removal of these teeth (Fig. 528). These should be straight, with grooved or crescent-shaped jaws accurately fitted to the necks of the teeth. The beaks should also be thin, so that they may be easily introduced under the gum, up to the edge of the alveolus. And, like the superior and inferior molar forceps, the handles should be large enough to prevent them from springing in the hand of the operator, with a hook formed at the end of one of them.

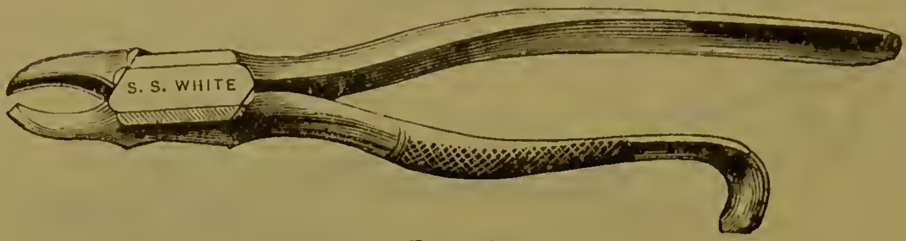


FIG. 528.

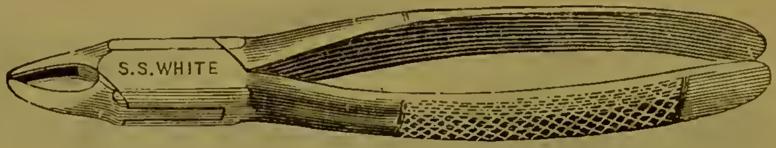


FIG. 529.

Owing to the difference in size between the superior central and lateral incisors, forceps with beaks much narrower than those of the common form of superior incisor forceps are frequently required for the extraction of the latter teeth. Fig. 529 represents an upper lateral incisor forceps with narrow beaks.

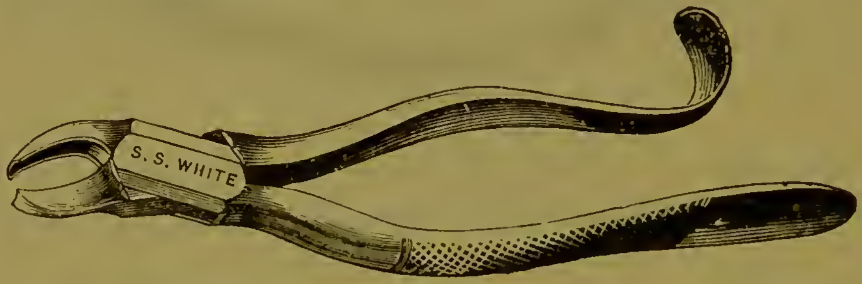


FIG. 530.

Fig. 530 represents another form of a superior cuspid and bicuspid forceps, in which the beaks curve more than those of the incisor forceps.

For the extraction of the lower incisors a pair of very narrow beaked forceps is necessary, to prevent interfering with the teeth adjoining the one to be removed. The beaks below the joint of the instrument should be bent downward at an angle of about twenty-five degrees with the handles (Fig. 531). This is also a very valuable instrument for the extraction of the roots of teeth.

An instrument similarly shaped, but with the beaks much longer, makes one of the most universally applicable instruments that can be devised (Fig. 532). The beaks should be made strong, but very narrow.

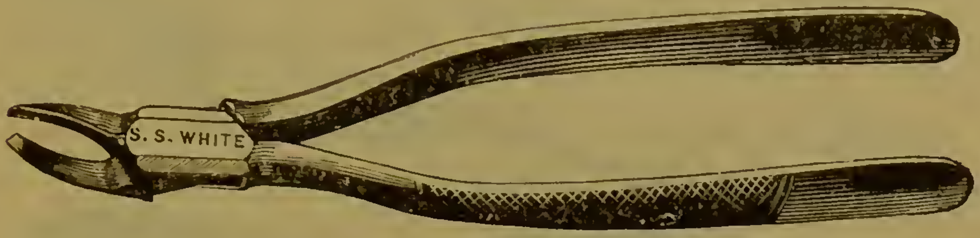


FIG. 531.

Fig. 533 represents an inferior incisor hawk-bill forceps, which is a very convenient instrument for the removal of these teeth. It is also used for the removal of the lower cuspids.

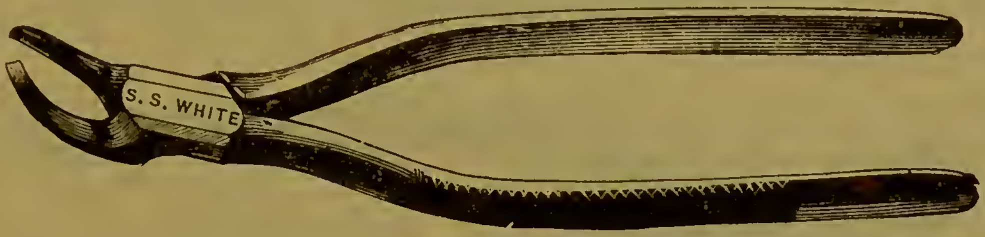


FIG. 532.

Forceps for the extraction of bicuspids should have their jaws so bent as to be easily adapted to these teeth; they should be narrow and have a deeper groove on the inside than those for the upper incisors and cuspids; like them, they should be thin, yet strong enough to sustain the pressure which it may be necessary to apply. One pair will answer for the right and left bicuspids of the upper jaw (Fig. 534).

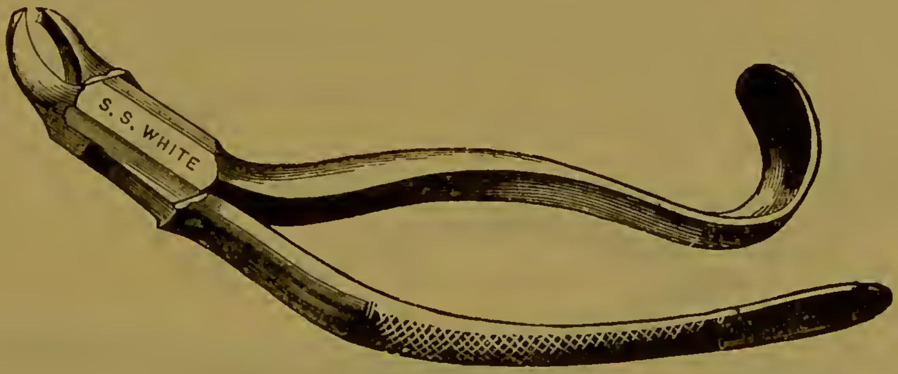


FIG. 533.

For the removal of the cuspids and bicuspids of the lower jaw the hawk's-bill forceps (Fig. 533), with crescent-shaped beaks, is often employed; but the instruments represented in Figs. 535 and 536 are, we think, better suited to the extraction of these teeth, and can be more conveniently applied. No separate instrument, therefore, is required for the removal of the inferior cuspids.

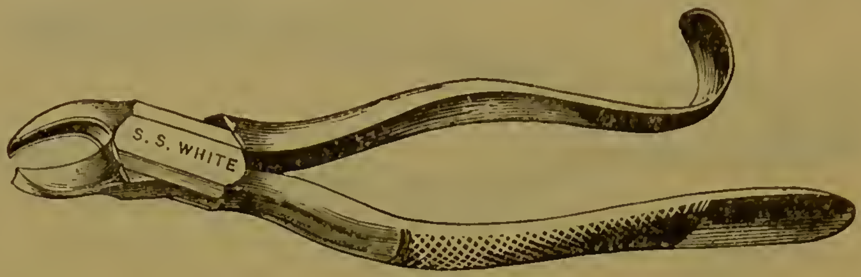


FIG. 534.

The dentes sapientiæ can, in many cases, be extracted with the universal bicuspid forceps, as shown in Fig. 535, which is half curved, with two concave beaks. But there is another kind of forceps which may be more conveniently employed for the removal of the upper wisdom teeth. The beak of these is bent above the joint, forming nearly two right angles, as shown in Fig. 537. These forceps were, we believe, invented by Dr. Edward P. Church about the year 1830, and in those cases where the superior dentes sapientiæ are considerably shorter than the second molars, they can be successfully and advantageously employed; and, indeed, in many cases they

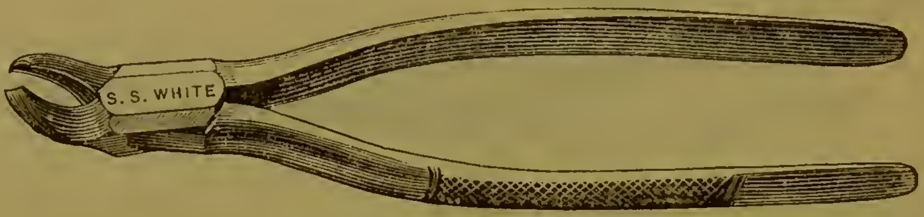


FIG. 535.

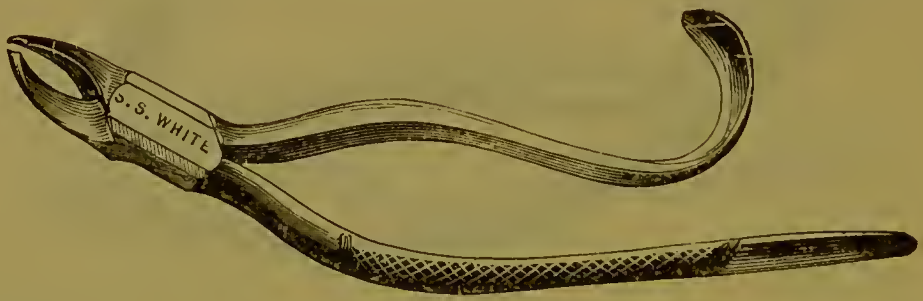


FIG. 536.

cannot be reached with any of the above-described extracting instruments. The handles of these, as of all other forceps, should be no longer than is absolutely necessary for the accommodation of the hand of the operator.

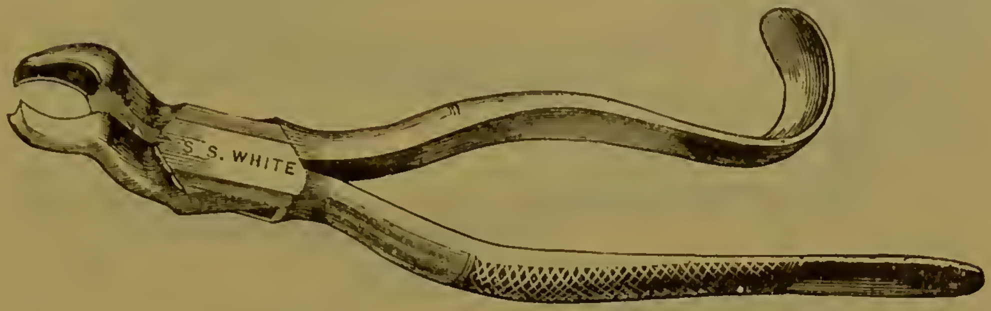


FIG. 537.

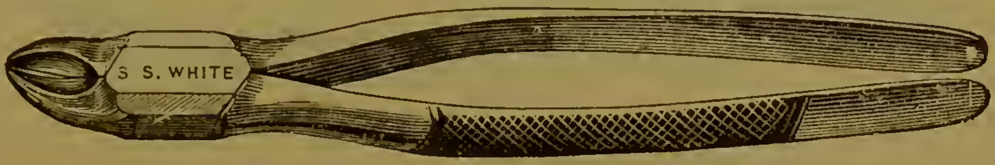


FIG. 538.

For the removal of the inferior dentes sapientiæ, the forceps represented in Fig. 524, Harris's pattern, or the ones represented in Figs. 526 and 527 may be employed. Fig. 538 represents Physick's dentes sapientiæ for either side, which is used as an elevating forceps.

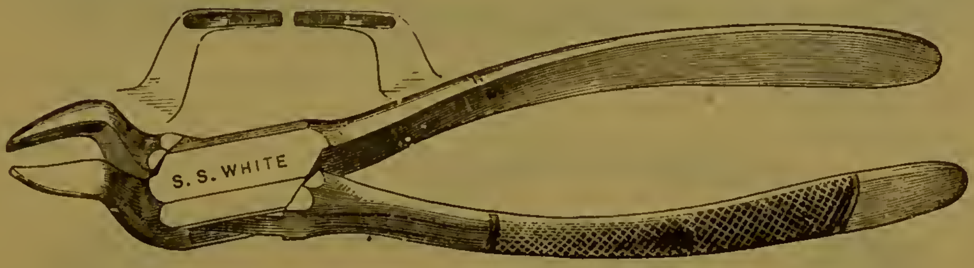


FIG. 539.

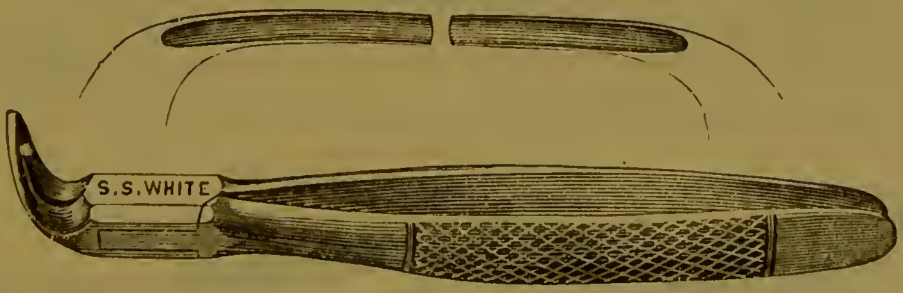


FIG. 540.

For the removal of the roots of the teeth the inferior incisor forceps represented in Figs. 531 and 532 are very useful; also the forms represented in Figs. 539 and 540.

Figs. 541, 542, 543, 544, and 555 represent Parmley's patterns of alveolar forceps for cutting through the alveolar process to the roots of the teeth.

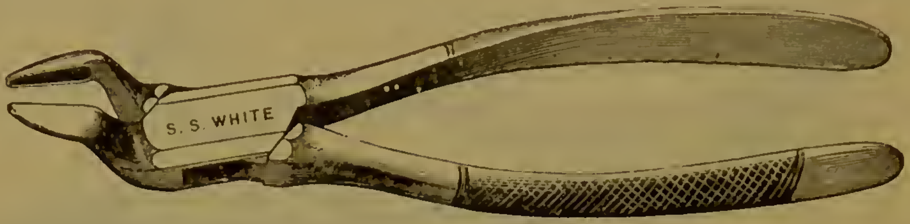


FIG. 541.

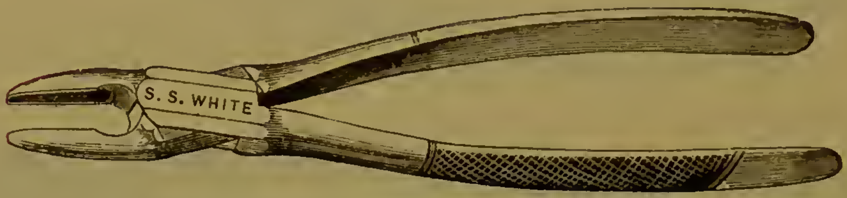


FIG. 542.

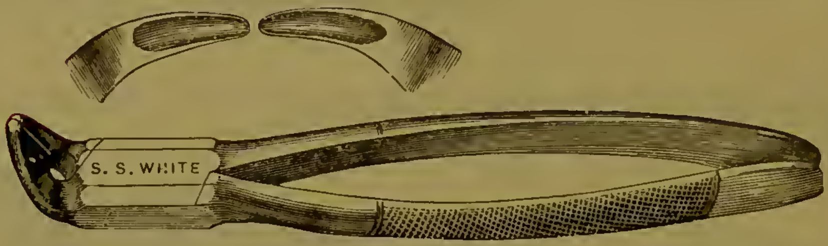


FIG. 543.

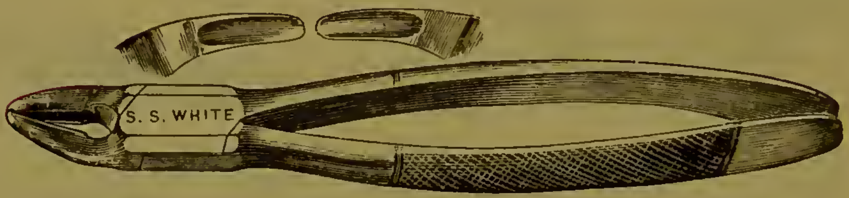


FIG. 544.

The following figures (545, 546, 547, 548, 549, 550, 551, 552, 553, 554) represent a set of ten forceps, called "Common Sense Forceps," which have recently been devised, and which present many useful features worthy of consideration :—

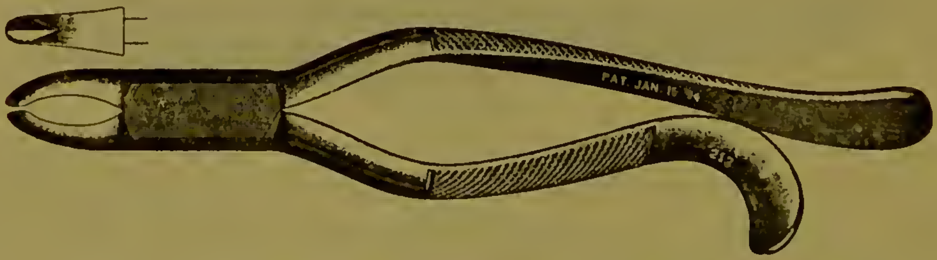


FIG. 545.—FOR UPPER CENTRAL INCISORS AND CUSPIDS, EITHER SIDE.

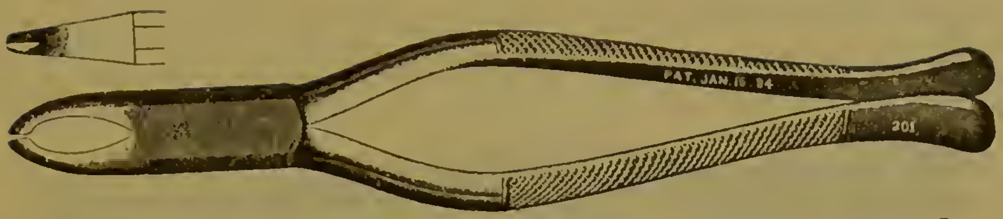


Fig. 546.—For Upper Lateral Incisors, Bicuspids, and Roots, Either Side.

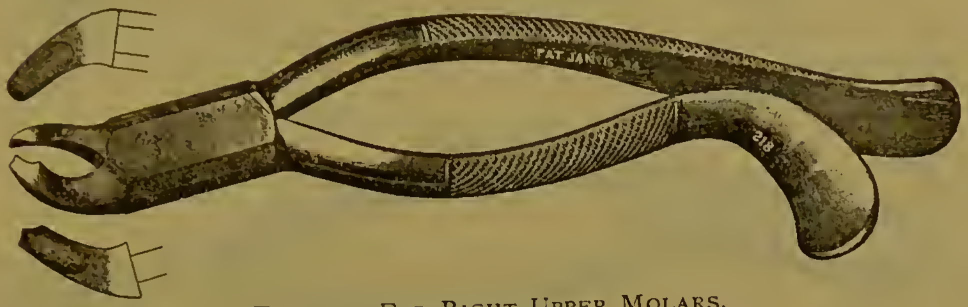


Fig. 547.—For Right Upper Molars.

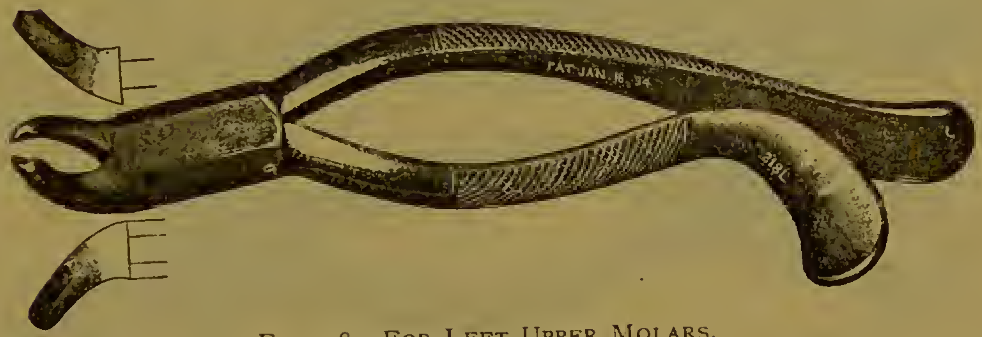


Fig. 548.—For Left Upper Molars.

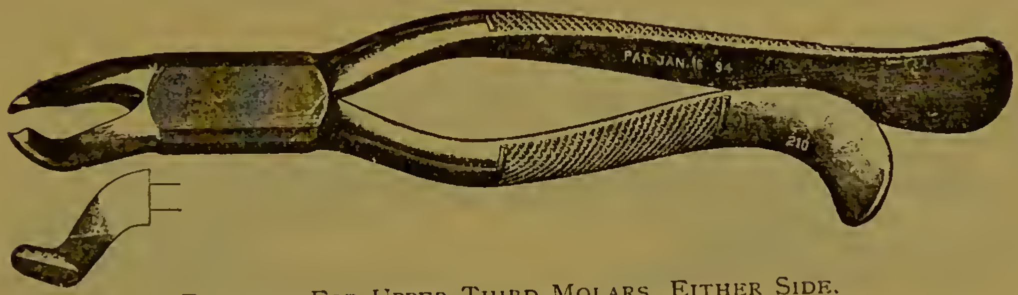


Fig. 549—For Upper Third Molars, Either Side.

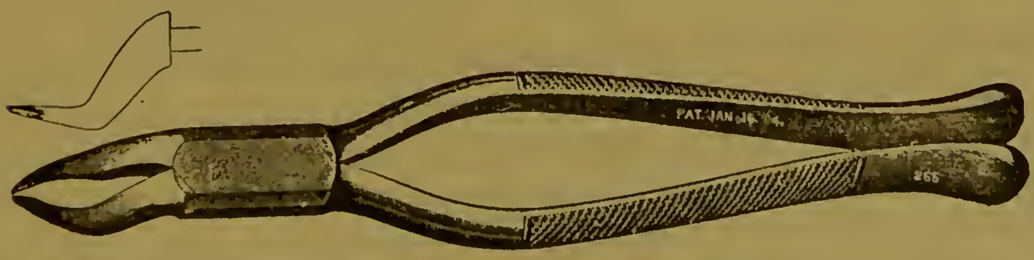


Fig. 550.—For Upper Roots and Spiculæ, Either Side.

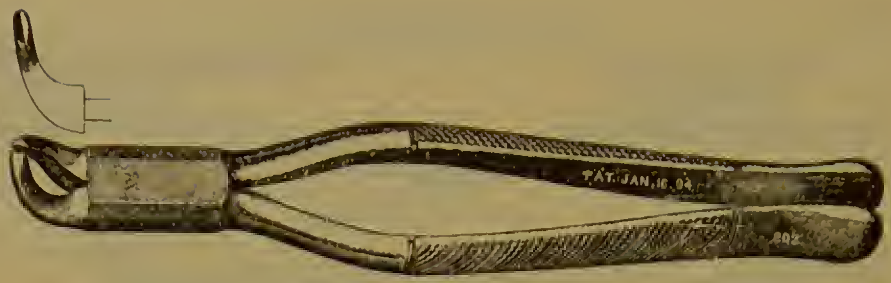


FIG. 551.—FOR LOWER INCISORS AND SINGLE ROOTS, EITHER SIDE.

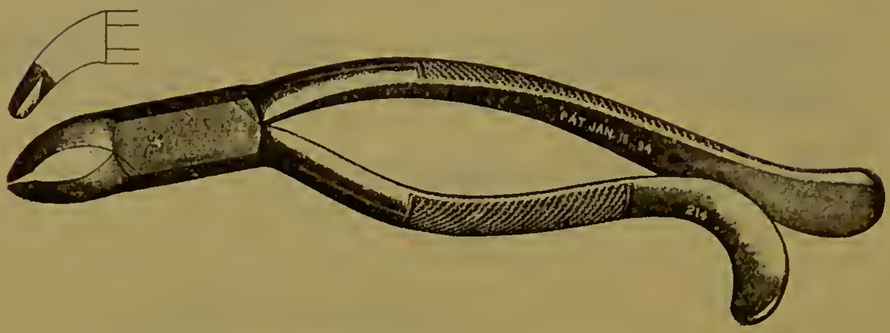


FIG. 552.—FOR LOWER CUSPIDS AND BICUSPIDS, EITHER SIDE.

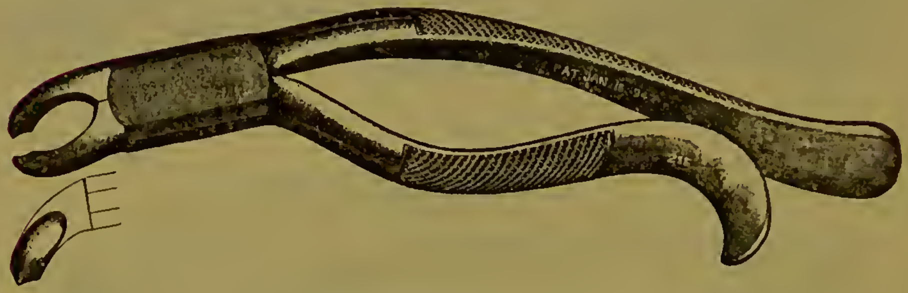


FIG. 553.—FOR LOWER MOLARS, EITHER SIDE.

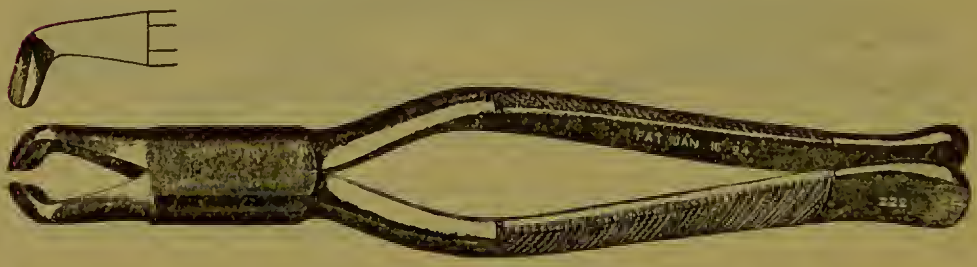


FIG. 554.—FOR LOWER THIRD MOLARS, EITHER SIDE.

Dr. W. Storer How writes of the "Common Sense Forceps" as follows: "There is scarcely any instrument used in dentistry that has called forth more ingenuity in devising various shapes than forceps. The object has been to provide a series of instruments of this class which will closely conform to the several classes of teeth, so that they may be removed with the least pain possible to the patient, and the expenditure of only the necessary force by the operator. As a general rule, ten forceps will answer for a complete set, but for the requirements of wide ranges of practice, supplemental forms of forceps will be desirable. Skill in the use of a moderate number of these instruments is preferable to crowding one's case with an unnecessary number."

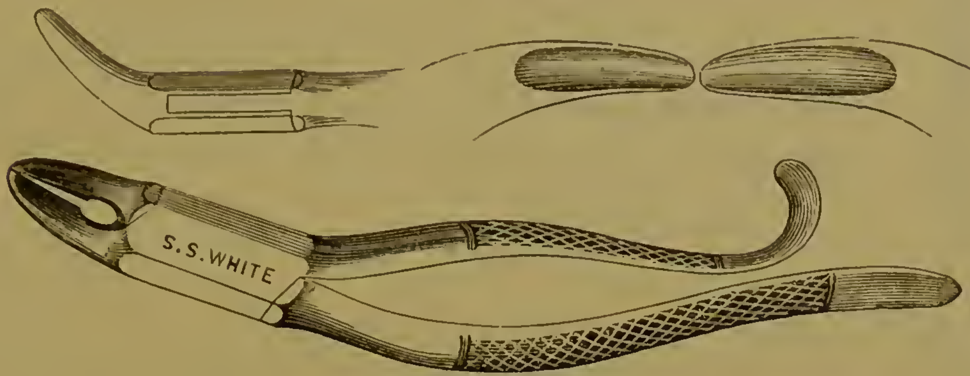


FIG. 555.

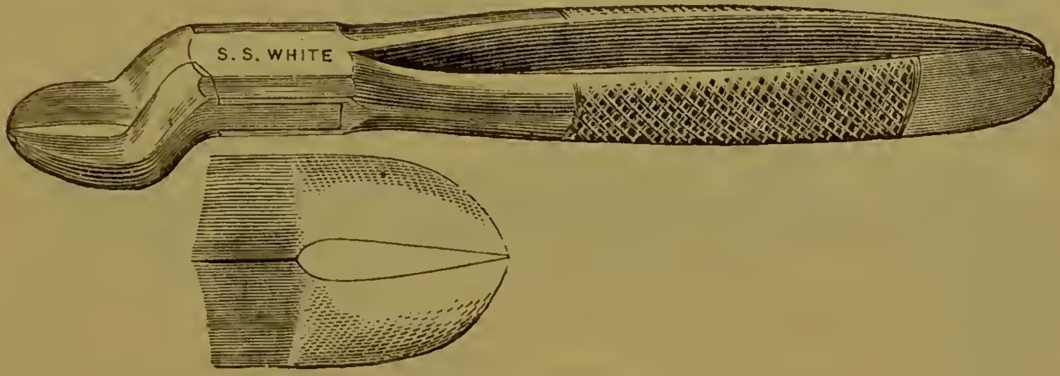


FIG. 556.—SUPERIOR.

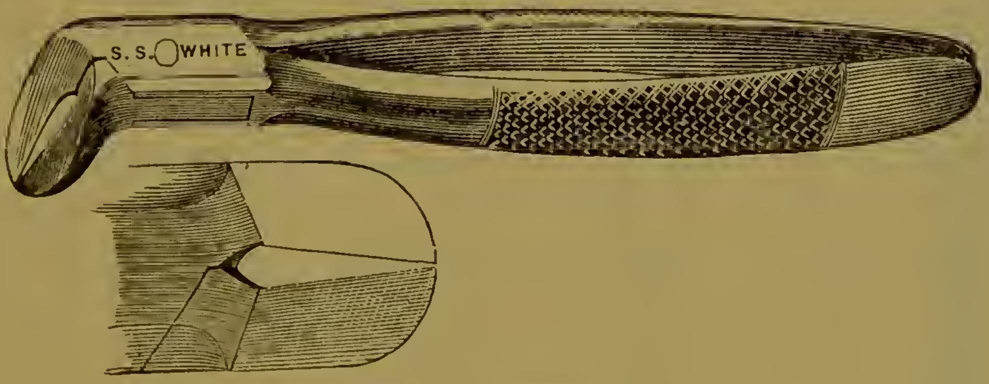
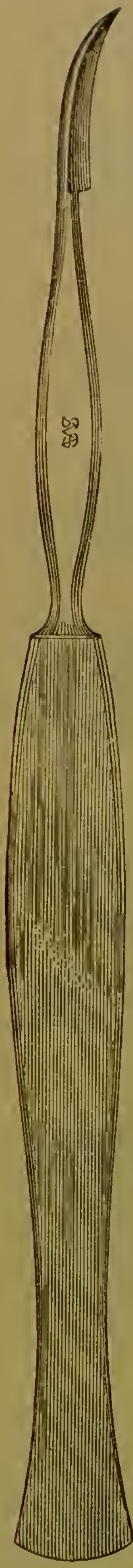


FIG. 557.—INFERIOR.

The form of forceps represented by Fig. 555 is very useful for the extraction of inferior cuspids and bicuspids, both right and left; also for the extraction of roots of inferior teeth.

Figs. 556 and 557 represent Stellwagen's superior and inferior for-



ceps for separating the diverging roots of molar teeth, and which may also be used as elevating forceps.

MANNER OF USING THE FORCEPS.

In describing the manner of using these instruments we shall commence with the extraction of the incisors of the upper jaw. These are generally more easily removed than any of the other teeth.

The use of the gum lancet should generally precede the application of either the forceps or the key. Many dentists object to the operation as unnecessarily inflicting double pain. Some have their forceps made with thin, sharp blades, so as to sever the gum on two sides in the act of pressing up the instrument. This practice may be admissible, perhaps necessary, in certain exceptional cases, as with children or nervous persons, whom the act of lancing might deter from permitting the operation to be completed. But we are fully satisfied that, as a rule, it is very objectionable, either in the use of the key or of the forceps. Owing to the great improvement in the form of the edges of the beaks of the forceps now manufactured, the use of the gum lancet is scarcely necessary, except in the case of teeth that stand alone, where lancing of the gum may prevent the laceration or tearing of the soft tissues, and also in the case of the wisdom teeth and roots of teeth imbedded in the gum.

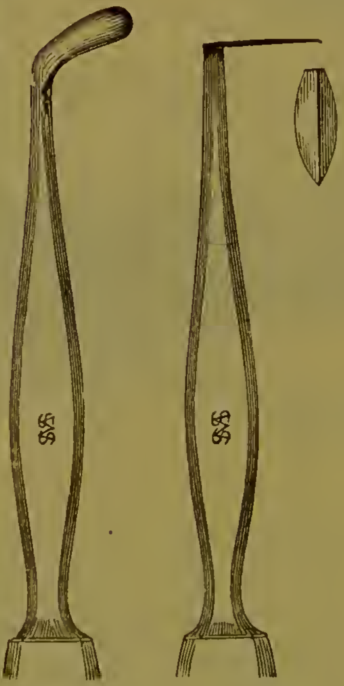


FIG. 558.

Figs. 558 and 559 represent several forms of gum lancets.

Fig. 559 represents a convenient two-blade gum lancet with stop.

After separating the gum, when necessary, from the neck of the tooth, the latter should be grasped with a pair of straight forceps (Fig. 528 or Fig. 530, or, in case the tooth is a lateral incisor, with a narrow crown, Fig. 529), and pressed several times in quick succession outward and inward, giving it at the same time slight rotary motion, which should be continued until it begins to give way; then, by a slight downward pull, it is easily removed. If the tooth is much decayed, it should be grasped as high up under the gum as possible, and no more pressure applied to the handles of the instrument than may be necessary to prevent it from slipping. Teeth are often unnecessarily broken by not attending to this precaution.

The same directions will, in most cases, be found applicable for the removal of a lower incisor. But the arrangement of these teeth is sometimes such as to render their extraction rather more difficult. The forceps best calculated for their removal are represented in Figs. 531 and 533.

For the extraction of a cuspid more force is usually required than for the removal of an incisor, because of the greater size and length of its root. The straight forceps (see Fig. 528 or Fig. 530) should be employed for the removal of the superior, and the curved-beaked forceps (Figs. 531, 536, and 545) for the inferior cuspids. In the extraction of these teeth less rotary motion should be given to the hand than in the removal of the incisors; in every other respect the operation is performed in the same manner. The inferior cuspids usually have longer roots, and are more difficult to remove than the superior.

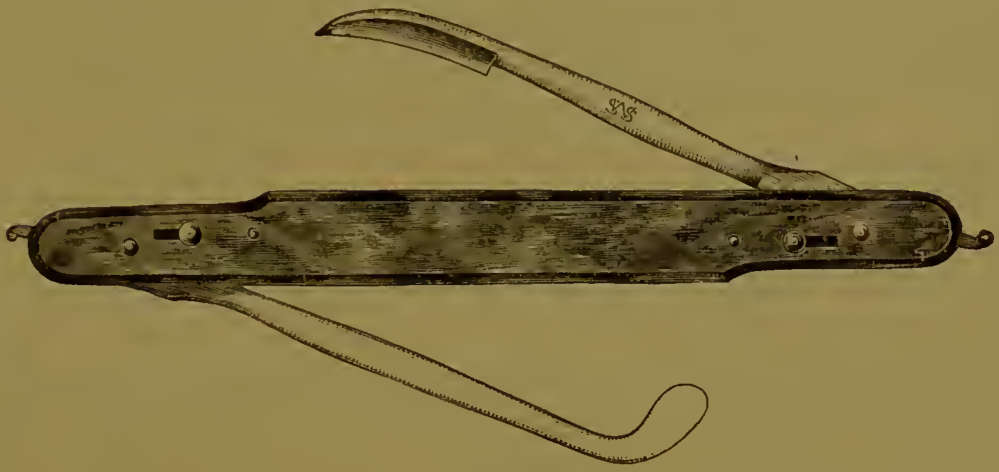


FIG. 559.

Very little rotary motion can be given to a bicuspid, especially an upper one, in its extraction. After it has been pressed outward and inward several times, or until it begins to give way, it should be removed by pulling in the direct line of its axis. For the extraction of the upper, the forceps represented in Fig. 528 and Fig. 530, and for the lower, those represented in Fig. 536 and Fig. 545 are the proper instruments to be employed, unless the crown has become so much weakened by decay that it will not bear the requisite amount of pressure. In this case the gum on each side should be separated from the alveolus about an eighth or three-sixteenths of an inch, and slitted so as to permit the application of the narrow-beaked forceps, Fig.

531. With these the alveolar wall on each side may be easily cut through, and a sufficiently firm hold obtained upon the root of the tooth for its removal. The forceps represented in Fig. 565 and Fig. 566 will be found better adapted for the removal of the molars, when in a similar condition, than any other instrument.

The upper molars, having three roots, generally require a greater amount of force for their removal than any of the other teeth. They should be grasped as high up as possible, with one of the forceps represented in Fig. 522 or 523, and then pressed outward and inward until the tooth is well loosened, when it may be pulled from the socket. If the forceps used for the extraction of the upper molars are of the right description and properly applied, they will be found the safest and most efficient instruments that can be employed for their removal.

The superior dentes sapientiæ are usually less firmly articulated to the jaw than are the first and second molars; they are therefore more easily removed. When their crowns are sufficiently long to admit of being grasped with the bicuspid forceps (Fig. 535), they may be removed with this instrument; but when this cannot be applied without interfering with the anterior teeth, the forceps represented in Fig. 536 may be substituted.

The inferior molars, although they have but two roots, are often very firmly articulated, and require considerable force for their removal; and it sometimes happens that, when the approximal side of one has been destroyed by caries, the adjoining tooth has impinged upon it in such a manner as to constitute a formidable obstacle to its extraction. Two teeth are often removed in attempting to extract one thus situated, unless the precaution is taken of cutting away the side of the encroaching tooth. This should never be omitted in the extraction of a lower molar or bicuspid locked in the manner just described. It sometimes, though less frequently, happens that the upper teeth impinge upon each other in the same manner; in this case, also, the adjoining tooth should be cut away sufficiently to liberate the one that is to be extracted before attempting its removal. In applying forceps to an inferior molar, the points on the beak of the instrument should be forced down between the roots; after having obtained a firm hold, the tooth should be forced inward and outward several times in quick succession, until its connection with the jaw is partially broken up, and then raised from the socket. If the tooth has decayed down to the neck, the points of the beak may include the upper edge of the alveolus, through which they will readily pass on applying pressure to the handles, and in this manner a secure hold will be obtained upon the tooth. The same should also be done in the extraction of a superior molar in this condition.

The dentes sapientiæ in the lower jaw, when situated far back under the coronoid process, are oftentimes exceedingly difficult to extract; but with forceps like those represented in Figs. 524, 527, or 545, they may always be grasped by an expert operator, except in those cases where their crowns have been destroyed by caries, when the cowhorn forceps represented in Fig. 567 will generally prove useful. It occasionally happens that the roots of these teeth are bent in such a manner as to constitute a considerable obstacle to their removal. But when this is the case, the roots are almost always turned posteriorly toward the coronoid processes; so that after starting the tooth, if the operator is unable to lift it perpendicularly from the socket, he will have reason to suspect its retention to be owing to an obstacle of this nature. To overcome this, as he raises his hand he should push the crown of the tooth backward, making it describe the segment of a circle; for should he persist in his efforts to remove it directly upward, the root will be broken and left in the jaw. Fig. 538 represents an elevating forceps useful in removing the dentes sapientiæ when they are but partially erupted or badly decayed. The points of the beaks of this forceps are inserted between the second molar and partially erupted wisdom tooth, the crown of the second molar being the fulcrum.

It sometimes happens that the roots of the first and second molars of both jaws and those of the superior dentes sapientiæ are bent, or else diverge or converge so much as to render their extraction exceedingly difficult. The convergency of these roots is often so great that, in their removal, the intervening wall of the alveolus is brought away; but neither from this, nor from the removal of a small portion of the exterior wall, will any unpleasant results follow. Similar malformations are occasionally met with in the roots of the bicuspids, the cuspids, and even the incisors.

Other obstacles sometimes present themselves in the extraction of teeth, which the judgment and tact of the operator alone will enable him to overcome. The nature and peculiarity of each case will suggest the method of procedure most proper to be pursued. The dentist should never hesitate to embrace a portion of the alveolus between the jaws of the forceps when necessary to enable him to obtain a firm hold upon the tooth. The removal of the upper edge of the socket is never productive of injury, as it is always subsequently removed, more or less rapidly, by the process of absorption. When the crown of a tooth has become so much weakened by disease that it will not bear the pressure of the instrument, it may be removed in this manner without inflicting upon the patient half the pain that would be caused by the attempt to spare the thin, perishable alveolar walls.

MANNER OF EXTRACTING ROOTS OF TEETH.

The extraction of roots of teeth is sometimes attended with considerable difficulty; but generally they are more easily removed than the whole teeth, especially the roots of the molars, for, after, the destruction of their crowns, an effort is usually made by the economy to expel them from the jaws. This is done by the gradual absorption of the alveolus, together with the filling up of the socket by a deposition of ossific matter at the bottom, whereby the articulation of the root becomes weakened and its removal rendered proportionately easier. The alveolar cavities are often wholly obliterated in the course of two or three years after the destruction of the crowns of the teeth, and the roots retained in the mouth simply by their connection with the gums, so that for their removal little more is necessary than to sever this bond of union with a lancet or sharp-pointed knife.

The instruments usually employed in the extraction of roots of teeth are the hook, punch, elevator, and screw, all of which are represented in Fig. 560, and also the root forceps shown in subsequent figures. Although every dentist has the former made to suit his own peculiar notions, the manner of using them and the principles upon which they act are the same. It will, therefore, be sufficient to say that they should be of a convenient size, made of good steel, and so tempered as neither to bend nor break.

The hook, No. 7, Fig. 560, is chiefly used for the extraction of the roots of molar and bicuspid teeth on the left side of the mouth; the punches, Nos. 3, 4, 5, 6, 10, 11, 12, Fig. 560, for the removal of those on the right side; the elevators, Nos. 2, 8, 9, 13, Fig. 560, for the extraction of roots on either side, as occasion may require; and the screw, No. 1, Fig. 560, for the removal of those of the upper front teeth.

Considerable tact is necessary for the skillful use of these instruments, and this can only be obtained by practice. Great care is requisite, in using the punch and elevator, to prevent them from slipping and injuring the mouth of the patient. Whenever, therefore, either of these are used, the forefinger of the left hand of the operator should be wrapped with a napkin and placed on the side of the root opposite to that against which the instrument is applied, so as to catch the point in case it should slip.

But for the removal of the roots of bicuspids and molars, and often for those of the cuspids and incisors, the narrow-beaked forceps recommended for the extraction of the lower incisors (see Fig. 531) may be used more effectively than any other instrument. When the root is decayed down to the alveolus the gum should be separated from it, and so much of it as may be necessary to obtain a secure hold upon the root included between the beaks of the forceps, for these, being very narrow, readily pass through the alveolus, and a firm hold is at once obtained upon the root; then, after moving it a few times outward and inward, it may easily be removed from its socket.

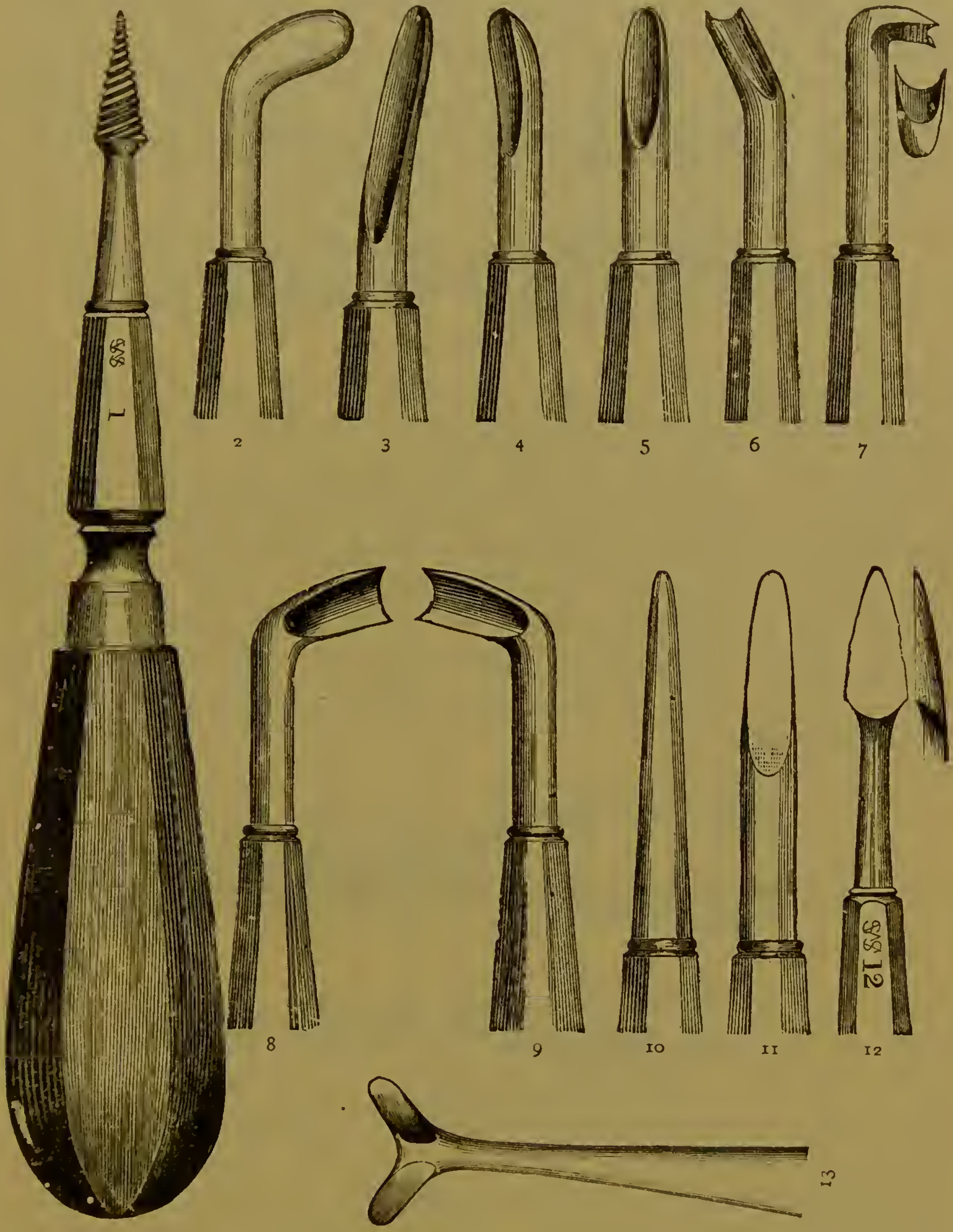


FIG. 560.

There are some cases, however, in which the punch, hook, and elevator may be advantageously used. We have also occasionally met with cases where we have succeeded in removing roots of teeth with great ease by means of an elevator shaped like the blade of a knife, first forcing it into the socket by the side of the root and then turning it so as to make the back press against the former and the edge against the latter. When this instrument, represented in Fig. 561, is used, the blade should not be more than an inch in length, and it should be straight, short at the point, and have a very thick back, that it may not break in the operation. In using the common elevator it is necessary that there should be an adjoining tooth or root to act as a fulcrum. When this can be employed, a root, or even a whole tooth, may sometimes be removed with it; but, as a general rule, forceps should be preferred to any of these instruments.

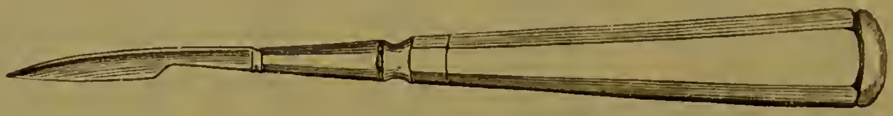


FIG. 561.

For the extraction of the roots of the upper front teeth, after they have become so much funneled out by decay as to render their walls incapable of sustaining the pressure of forceps, the conical screw may be employed. With this a sufficiently firm hold for the removal of the root may be obtained by screwing it into the cavity. But before it is introduced the soft decomposed dentine should be removed from the interior of the root with a triangular-pointed instrument like the one represented in Fig. 562.

Dr. S. P. Hullihen has invented a most valuable and useful instrument for the removal of the roots of the superior incisors and cuspids when in the condition just described. It combines the advantages both of the screw and forceps, as may be seen by the accompanying cut. It is thus described by the author: "Lengthwise, within and between the blades of the beak, is a steel tube, one end of which is open, the other solid and flat, and jointed in a mortise in the male part of the joint of the forceps. When the forceps are opened, this joint permits the tube to fall backward and forward from one blade of the beak to the other, without any lateral motion. Within this tube is a spiral spring, which forces a shaft up two-thirds of the tube; the other part is a well-tapered or conical screw. . . . The shaft and tube are so fitted together and to the beak of the forceps that one-

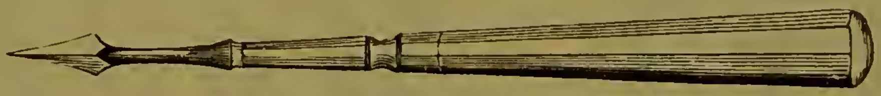


FIG. 562.

half of the rounded part of the shaft projects beyond the end of the tube, so that the shaft may play up and down upon the spring about half an inch, and the screw or shaft be embraced between the blades of the beak of the instrument."

Dr. Hullihen's instrument is represented in Fig. 563.

"The forceps," says Dr. Hullihen, "are used by first embracing the shaft between the blades.* Then, screwing it as gently and deeply into the root as possible, the blades are opened and pushed up on the root, which is then seized and extracted. The screw thus combined with the forceps prevents the root from being crushed. It acts as a powerful lever when a lateral motion is given; it is likewise of advantage when a rotary motion is made; it prevents the forceps from slipping or from losing their action should one side of the root give way in the act of extracting it, and is used with equal advantage where one side of the root is entirely gone."

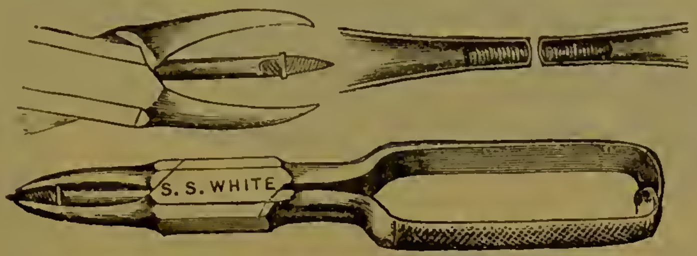


FIG. 563.

Fig. 564 represents Dubs's screw forceps: 1. Conical screw, with square ratchet shaft. 2. Beaks of forceps, grooved inside. 3. Socket with square hole to receive shaft. 4. Spring trigger, by which the screw can be detached at pleasure at any given point.

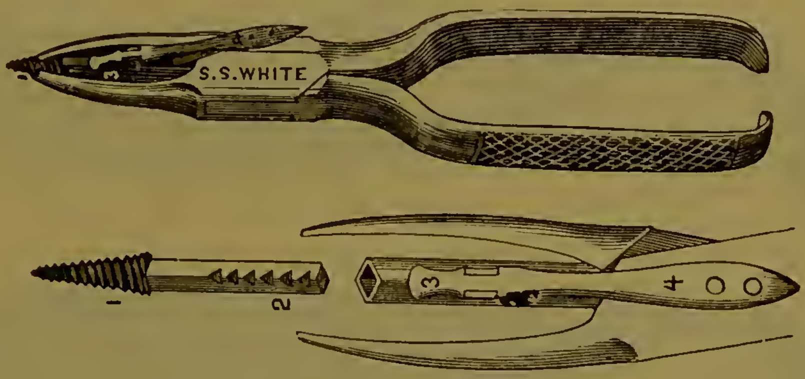


FIG. 564.

For the extraction of the roots of the upper molars before they have become separated from each other by decay, the forceps (Fig. 565) invented by Dr. Maynard will be found highly valuable. The outer beak of each instrument is brought to a sharp point for perforating the alveolus between the buccal roots and for securing between them a firm hold, while the inner beak is intended to rest upon the edge of the alveolus and embrace the palatine root. By this means a sufficiently firm hold is secured to enable the operator to remove the roots of an upper molar without difficulty. Two pairs, as represented in the engraving, one for the right and one for the left side, are required.

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* The author has a pair constructed so that the blades of the beak of the forceps grasp the upper extremity of the screw instead of the shaft.

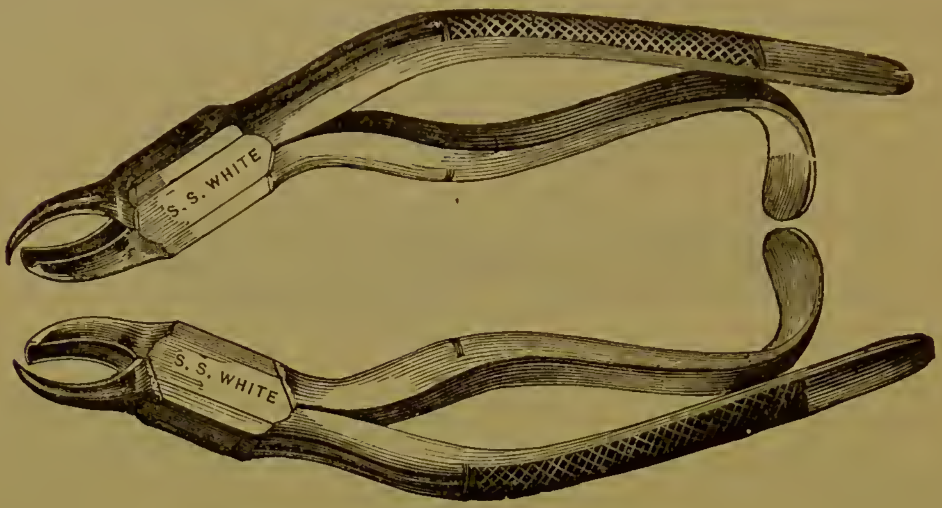

FIG. 565.

Fig. 566 represents a form of forceps recently introduced, which is also used for the extraction of the roots of the superior molars before they have become separated by decay; a right and left are required.

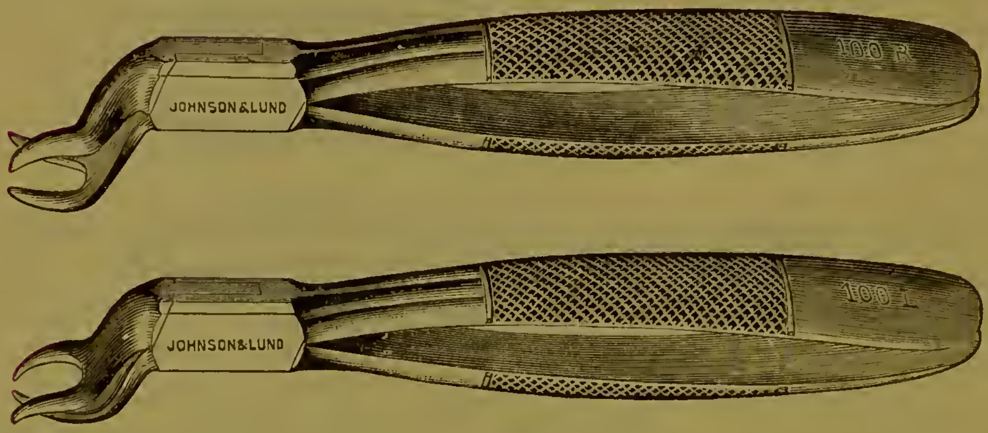

FIG. 566.

Fig. 567 represents a lower molar cowhorn forceps for either side; right and left forceps of this pattern are also used.

Fig. 568 represents a lower molar cowhorn forceps for either side, one beak being longer than the other.

The advantage to be derived from forceps of this description must be apparent to every dentist.

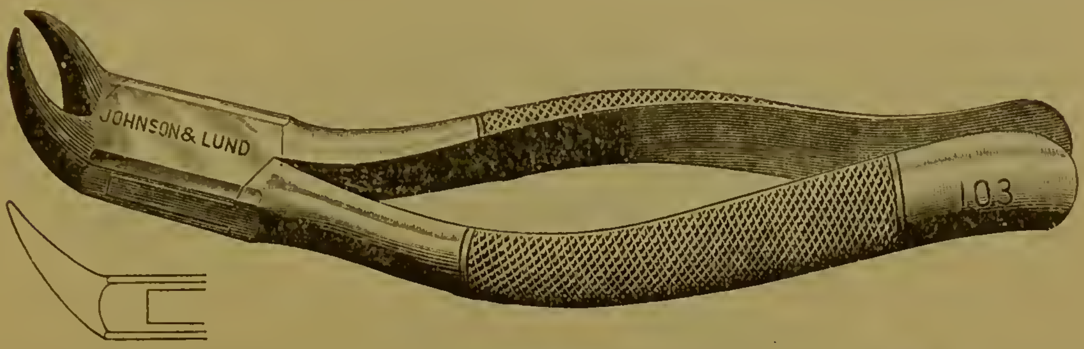

Fig. 567.

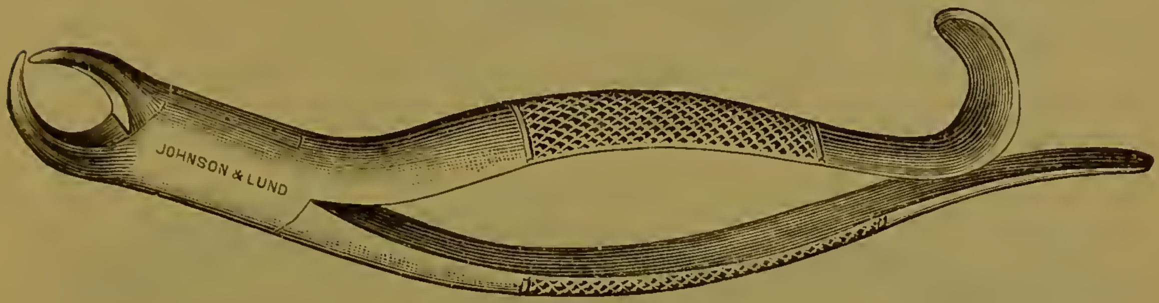

Fig. 568.

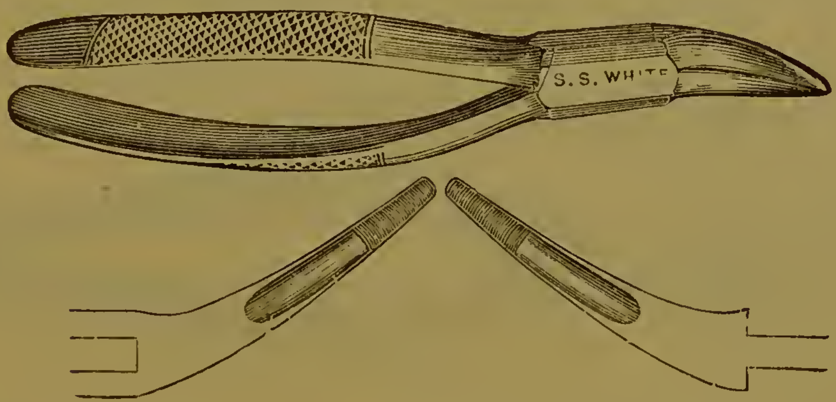

Fig. 569.

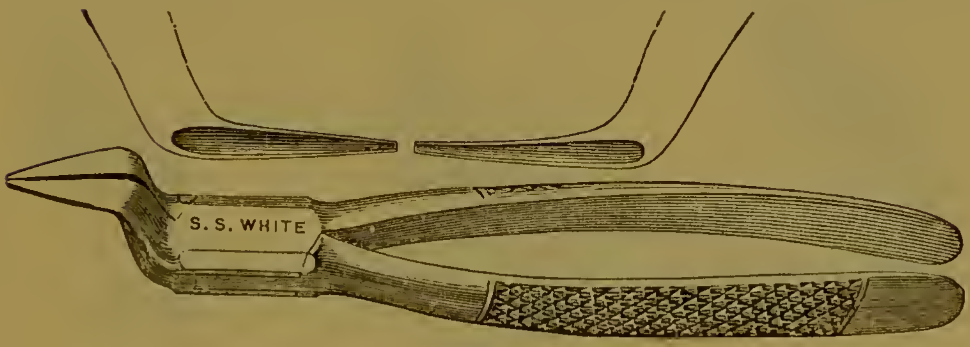

Fig. 570.

Fig. 569 represents Tomes's universal root forceps, which is a very useful form for the extraction of fragments and small roots of teeth.

Fig. 570 represents Arrington's bayonet-shape, slender beak forceps for the extraction of difficult roots in the upper jaw and roots of front teeth in the lower jaw.

Figs. 571 and 572 represent front and back alveolar nipping for-

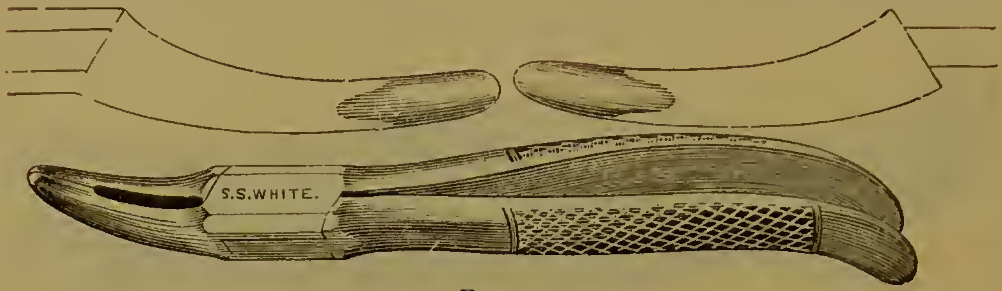

FIG. 571.

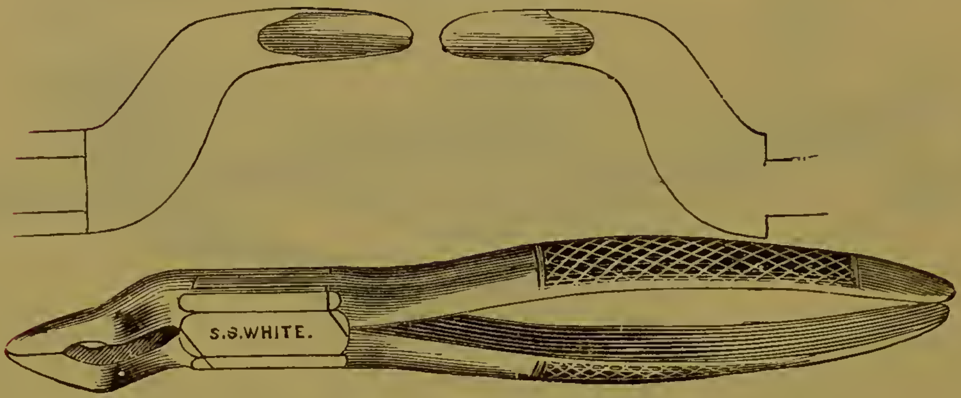

FIG. 572.

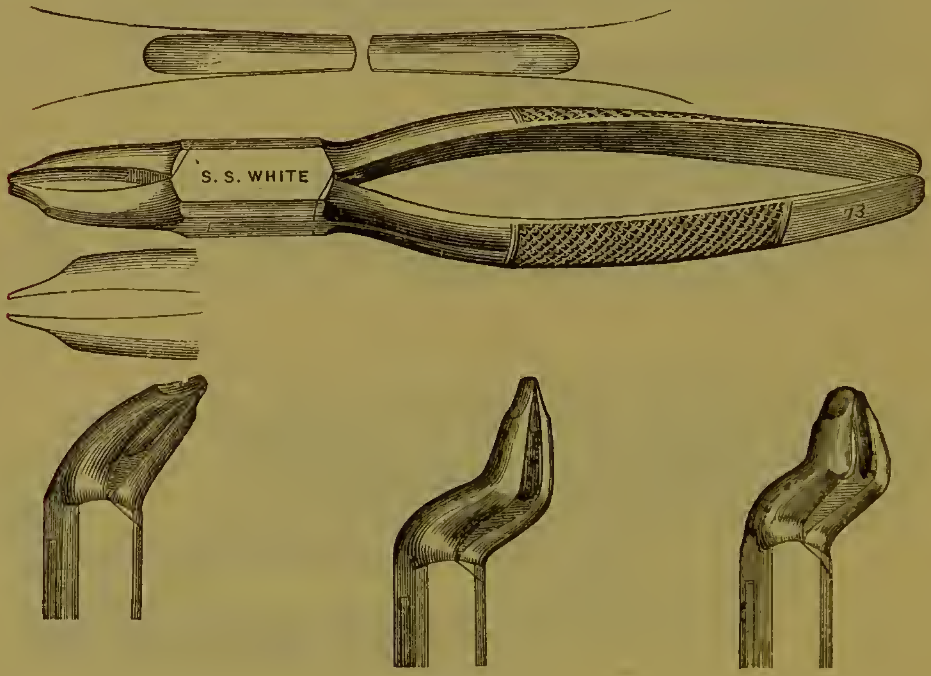

FIG. 573.

ceps, for cutting away processes after extraction, and which may also be used for removing roots of teeth.

Fig. 573 represents Tees's sub-alveolar thin-pointed forceps, which are designed to slip within the alveolar process and into the tooth-socket to remove teeth the crowns of which are entirely decayed or broken off.

EXTRACTION OF THE TEMPORARY TEETH.

The temporary teeth should be extracted in the same manner as the permanent, and with the same instruments. If the power be properly directed very little force is required for their removal, because the roots of these teeth have generally suffered more loss of substance before the operation is called for; and when they remain, the alveolar processes at this early age are so soft and yielding as to offer little resistance to the tooth.

The operator should be careful not to injure the pulps of the permanent teeth or the bone of the jaw. Serious accidents sometimes occur from an improper or awkward removal of these teeth. But, as has been before remarked, their extraction is seldom required. It should only be resorted to for the relief of toothache, the cure of alveolar abscess, to prevent irregularity in the permanent teeth, or in case of necrosis of the socket. And even in such cases it is necessary to exercise much judgment in deciding how far pain and inconvenience should be endured rather than extract the offending tooth; or how far the chance of injury to the permanent teeth demands the removal of the diseased temporary teeth. Their premature extraction is so often followed by a crowded state of the permanent teeth, that their indiscriminate removal for trifling causes cannot be too strongly condemned.

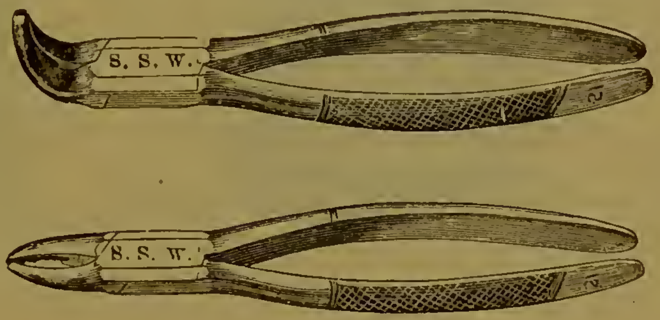

FIG. 574.

Fig. 574 represents forceps, curved and straight, for the extraction of children's teeth.

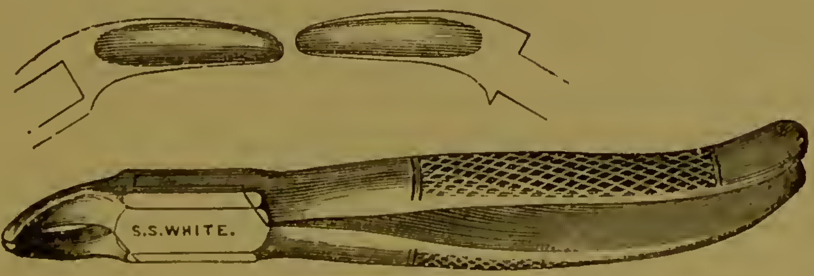

FIG. 575.

Fig. 575 represents forceps for the extraction of children's teeth, and which will also answer as universal root forceps.

The possibility of septic affections in connection with the extraction of teeth, such as necrosis of jaws, diffuse abscess, erysipelas, etc., is now universally admitted, hence the necessity existing for antiseptic precautions, such as the effective sterilization of all instruments employed. The immersion of instruments in a boiling one or two

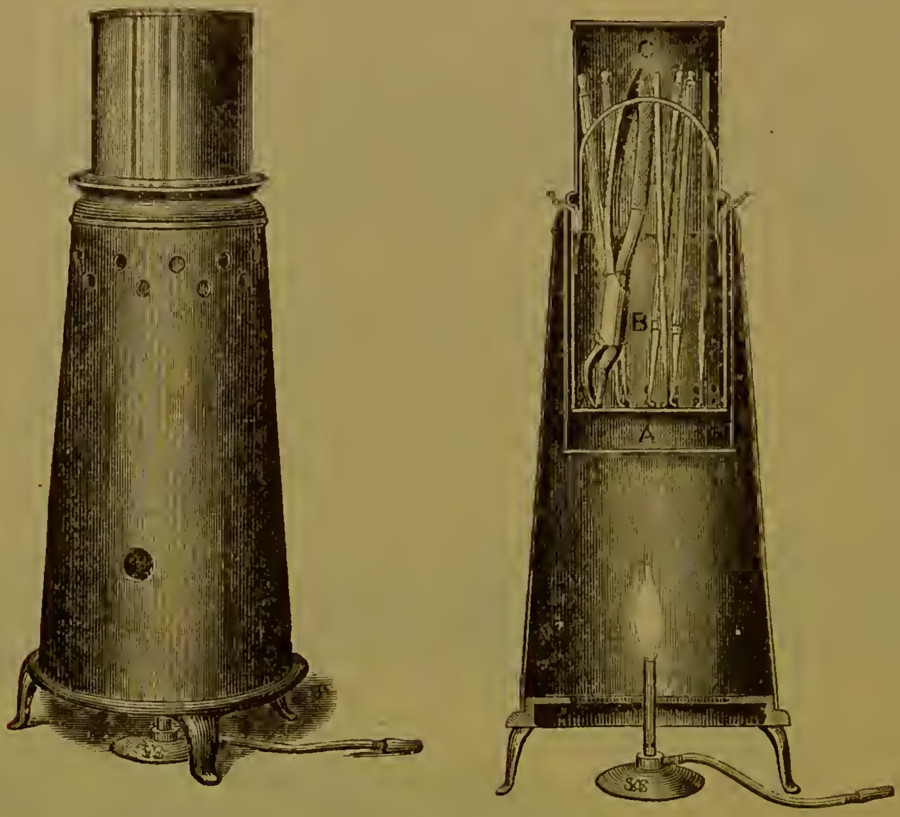

FIG. 576.

per cent. solution of soda will answer such a purpose. Fig. 576 represents Dr. E. D. Downs's apparatus for sterilizing instruments.

HEMORRHAGE AFTER EXTRACTION.

It rarely happens that excessive hemorrhage follows the extraction of a tooth. Indeed, it is oftener more desirable to promote bleeding by rinsing the mouth with warm water than to attempt its suppression, especially after the extraction of teeth affected with periodontitis, as such hemorrhage relieves the congestion of the parts and hastens recovery. Nevertheless, cases do sometimes occur in which it becomes excessive and alarming. It has been known in some instances to terminate fatally; this, however, does not appear to be dependent upon the manner in which the operation is performed, but rather upon a hemorrhagic diathesis of body, attributable to a deficiency in the coagulating property of the blood, a defibrinating condition, or hereditary predisposition. Hence, whenever a tendency to it exhibits itself in one member of a family, it is usually found to exist in all.